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FEDERAL SECURITY AGENCY
Public Health Service
Communicable Disease Center
Atlanta, Ga.

• In this issue: **BLUEPRINT FOR MALARIA ERADICATION IN THE U.S.**

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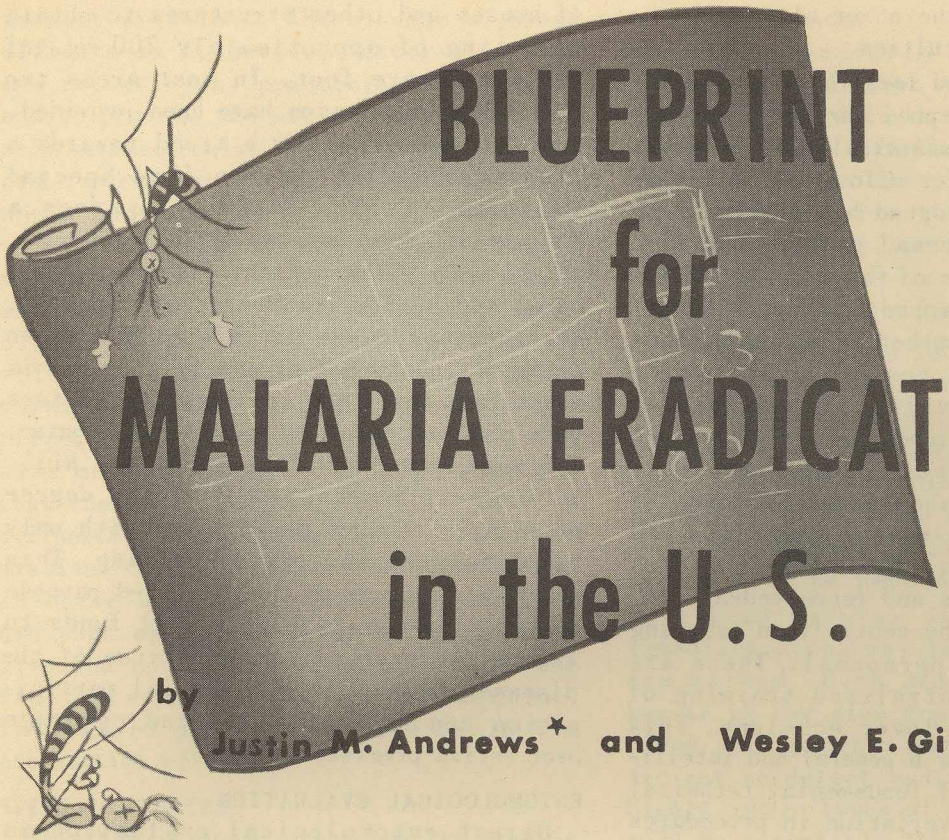


BLUEPRINT for MALARIA ERADICATION in the U.S.

by Justin M. Andrews* and Wesley E. Gilbertson*

The eradication of malaria as a significant public health problem in the United States has been proposed as a cooperative enterprise of the State Departments of Health concerned and the U. S. Public Health Service. Through this joint effort, an attempt is being made to reduce the incidence of the world's No. 1 communicable disease to virtual extinction in a large, defined area. Many specific and non-specific beneficial agents affecting the transmission and maintenance of malaria have produced a favorable set of circumstances which make such a program feasible. The health organizations of the affected areas, therefore, are collectively "striking while the iron is hot."

SELECTION OF PROCEDURES

In selection of procedures, three approaches were considered: (a) the elimination of malaria parasites in human residents of the areas; (b) the complete annihilation of the insect vectors of malaria; and (c) attritional eradication effected by concurrent reduction of malaria parasites and vectors to the point where general malaria transmission cannot occur.

There are certain inherent weaknesses in the first two methods. The lack of suitable means for mass destruction of the parasites in man by medication and the practical difficulties for such therapeutic administration to the general public in affected areas eliminate the first. The technical and operational difficulties connected with any attempt at country-wide eradication of native anopheline species, as well as the prohibitive cost of a program, eliminate the second. The last approach, therefore, was selected as the only one practicable for achieving malaria eradication in the United States. It is believed to be the most economical and efficient plan because it incorporates

* Dr. Andrews, Scientist Director, is Deputy Officer in Charge and Mr. Gilbertson, Engineer, is Executive Officer of CDC.

the advantages of the other alternatives, without their difficulties.

Federal, state, and local health agencies generally have accepted the challenge and have embarked enthusiastically on the five-year program of major effort. The administrative pattern adopted has provided for establishment of broad general policies within the mandates of Congress and under terms of federal appropriations. Actual administration of authority and management of operations is vested in the state departments of health. Technological information is developed and tested through laboratory and field investigations. Information is disseminated by means of printed and audio-visual materials and personal contacts. The uniform use of recent developments and recommended practices is promoted by centralized training courses for key personnel. These are followed by decentralized training of personnel in the lower echelons. This concept provides for a general and intelligent application of fundamental technical principles. Also, variation in procedures due to local circumstances, where desirable, are allowed. The plan of organization permits the establishment and application of national policies to the program as a whole. Administration invested in state and local departments of health encourages permanent and active malaria control organizations at these levels.

CONTROL METHODS

In the control program principal reliance is being placed (1) on killing of adult anophelines in human habitations using residual insecticides and (2) improved diagnosis and treatment of malaria cases. The organized field activity — DDT residual spray applications in houses and other human habitations — is conducted by the various State — CDC Activities organizations in the areas of traditional greatest malaria endemicity. The usual unit of operation is the county. Projects are mostly county-wide because of substantial local financial participation. The DDT treatments consist of applying emulsion to all interior wall surfaces and porches of houses and other structures to obtain a coating of approximately 200 mg. of DDT per square foot. In most areas two treatments per season have been provided. However, there is now a trend towards a single spray per season (See Special Projects, p. 57). In marginal areas a system of "spot spraying" is followed, in which only the houses of known malaria cases and nearby residences are sprayed. Where actual cases of malaria are known to exist, treatment of entire premises is practiced. Complete spraying of premises on a routine basis is desirable, of course, for more comprehensive anopheline kill. It appears, however, that a high degree of malaria control is obtained with only routine house and privy spraying. This practice conforms to the expressed purpose of utilizing available federal funds to reduce the over-all transmission of the disease. Larger local financial participation can be used to extend coverage over entire premises.

ENTOMOLOGICAL EVALUATION

Direct entomological evaluation is obtained by afternoon inspections of random samples from sprayed premises at varying periods subsequent to spray treatment. Experience indicates that *Anopheles* mosquitoes are eliminated from practically all treated houses if the DDT has been applied properly.

SPRAYING BY HOUSEHOLDERS

The increased use by householders of both space and residual type insecticides is being encouraged. The mass awareness of, and use of, insecticides by the public in their homes strikes a mighty blow at the specific insect vectors of disease.

EPIDEMIOLOGICAL ACTIVITIES

Improved knowledge of current malaria prevalence is vital to both intelligent direction of the insecticidal program and a concentrated attack on the detection and treatment of actual cases. To obtain this knowledge epidemiological field services are being strengthened. Medical and nurse officers are being assigned to epidemiologists in states where malaria

is most prevalent. The mission of these officers is to develop better diagnosis and reporting by practicing physicians, and to promote the use of the best available antimalarials. A follow-up of reported cases serves to accent accuracy in diagnosis and permits direct exposition of modern methods of treatment. Public health nurses are furnished to supplement available medical talent in malaria epidemiology. The nurses will also serve as stimuli to the general public health nursing program in encouraging a larger proportion of existing malaria cases to seek medical attention. It is expected that these field activities will serve to delineate areas of probable malaria transmission. Concentrated entomological study in these areas will follow. Procedures are thus established for a logical progression to point control efforts on the country's foci of residual infection. This is of obvious importance in the eradicative effort.

SPECIAL STUDIES

In a few selected areas special studies are to be undertaken in order to determine intimately the epidemiology of malaria, particularly with respect to the maintenance of the disease in human populations. These "listening posts" will be located in areas of previous hyperendemicity where transmission factors can be analyzed and where malaria will be most likely to return. In addition to a thorough study of the human cases, an ecological appraisal of the vector species will be undertaken. In this way, circumstances tending to permit transmission of the disease and factors associated with malaria recession will be determined. This information may help to break the links in the chain of malaria transmission.

FUTURE PLANS

The first year of the present program has ended. Control operations are underway in approximately 80 percent of the 440 most malarious counties of the country (counties having five or more cases per 100,000 during 1938-1942). Present plans call for the early extension of operations to the remainder of these counties and to isolated malaria foci in marginal territory. Sufficient epidemiological and entomological data on the results being obtained should be available at about the mid point in the program. This knowledge will allow a thorough evaluation of progress. Also, possible revisions in general procedures or in selection of project areas will be considered.

Although prospects for the success of the eradicative effort by the end of 1951 are very bright, it is not believed that its success will end the need for malaria prevention work in this country. Programs in many areas will, no doubt, be continued on a "maintenance basis". Constant supervision will be necessary to detect any localized revival of malaria so that immediate steps may be taken to prevent its spread. Each state department of health in the area concerned should continue to support a minimal program sufficient to detect and control outbreaks. Highly mobile types of staff and equipment will be essential. The great sensitivity to malaria among people as they gradually become unaccustomed to its ravages will assist this work in the intelligence phases and in elicitation of public support. Reintroduction of the disease must be considered. It is encouraging to note the significant plans for strengthening malaria control in Mexico through initiation of a large DDT residual spray program. Technical personnel for this work are now being mobilized. Many other countries are also devoting strenuous efforts along similar lines (See Special Projects p. 57). Since malaria introduced in other areas will not likely be transmitted, ports-of-entry in the southeast would be the principal sources of concern. Controlling transmission in the traditional malaria belt would be the task of the mobile units. It is hoped that in the years to come malaria may be included in the same category as yellow fever and dengue – diseases which are prevented from becoming problems in this country by supervision and quarantine activities.

Georgia • MALARIA CONTROL OPERATIONS

by Louva G. Lenert* and William A. Legwen*

The Malaria Eradication Program in Georgia was conducted in 51 counties during 1947. Comparison of Maps 1 and 2 indicates that operations were confined to areas with a history of significant malaria endemicity. The Eradication Program in Georgia is organized and financed to obtain maximum effectiveness.

ORGANIZATION. The State CDC Director maintains liaison with CDC Headquarters and determines general plans and policies. Negotiations with county boards of health and county commissioners are conducted by the director or by subordinate personnel working under his direction. CDC personnel serve as representatives of the state health department and of existing local health departments. Technical supervision is furnished by the Engineering Division of the state health department. The Assistant State CDC Director is responsible for execution of the program established by the Director and is in immediate charge of all state office, state warehouse, and field operations.

The 51 counties in which 1947 operations were performed were grouped into 16 areas and four districts (Map 3). One supervisor employee was in charge of each county area and district. In multi-crew counties, one assistant, or contact man, was employed for each two crews.

FINANCIAL PARTICIPATION. In 1945, when only 11 counties were involved, (except for warehouse and office space and state employed personnel) funds for the entire program were provided by USPHS. The 11 counties selected were among those having the highest malaria morbidity and mortality during the past 25 years. In the immediate vicinity of these counties, public demand for the spray program permitted expansion to three other counties where malaria control was justified, the additional counties providing substantial financial participation in the form of personnel and vehicles. In 1946, all counties furnished crew personnel, provided and maintained one vehicle for each crew, and supplied warehouse and office facilities. For that calendar year, the total county financial participation amounted to $121,774. This was an average of $0.77 per house spray application.

Again, in 1947 crew personnel, crew transportation, and warehouse and office facilities, plus contact personnel in all multi-crew counties, were provided by local government. Total financial participation amounted to $171,046, which was $0.78 per house spray application. The Georgia Department of Public Health continued to furnish services of the State Director, cartographic and drafting personnel, and many miscellaneous items. The USPHS provided chemicals and supervisory services, other than those of the State Director, transportation for supervisory personnel and most of the spray equipment, state warehouse facilities, and other items not supplied locally. County funds were usually obtained by tax. A few counties, however, used public or private subscriptions, the funds raised being turned over to county officials and used in the same manner as tax funds. Under this financial plan, no householder was refused residual spraying service

* Mr. Lenert, Georgia Department of Public Health, is State CDC Director and Mr. Legwen, Sanitary Engineer (R) is Assistant State CDC Director for Georgia.

because he did not contribute directly to program costs.

It is planned that in 1948, the same participation will be continued locally and that additional funds for minor equipment purchases will be available. In one-crew counties local officials will provide part-time personnel for contact work or provide money to hire such personnel.

EQUIPMENT. In 1945 operations were begun with the equipment and procedures developed or specified by USPHS except that emulsion was mixed in 30 to 50 gallon batches, instead of one or two gallon batches. Hand sprayers and power sprayers were utilized at this time.

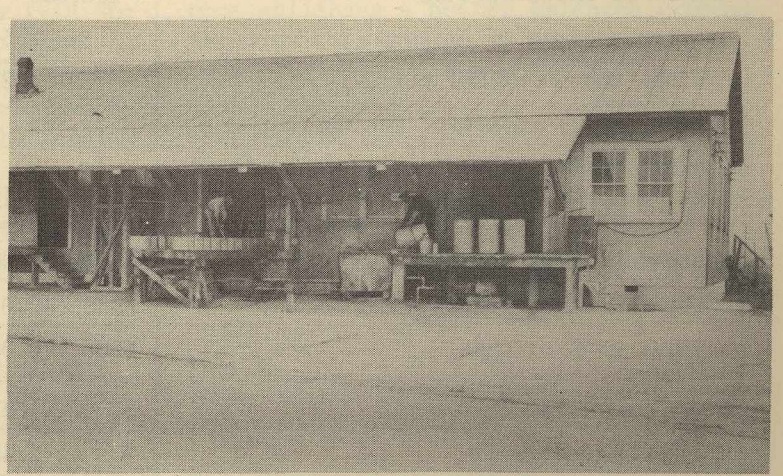
Because of difficulties encountered in maintaining and operating the hand sprayers, attempts were made to develop more efficient methods.

In June 1945, a 40 gallon hot water tank was obtained and converted into a compressed air tank by the addition of plugs, air filling valve, air gage, shut off valve, hose, and automatic chuck. Pumps were removed from several hand sprayers and air filling valves were installed. The compressed air tank was loaded to a pressure of 135-150 psi from which a hand sprayer could be loaded to a pressure of 50 psi. Field tests soon indicated that a production gain of approximately 25% was effected by this method. Although additional air tanks were difficult to acquire, by September 1945 all spray crews were equipped with them and hand sprayers were modified. Since, with the modified hand equipment, spraying operations could be performed faster than with the power sprayers, the power sprayers were withdrawn from use.

While the modified hand sprayers were superior to those used originally, they still had several objectionable features. A "Regulated Pressure Sprayer" was developed which overcame many of these difficulties (See "Idea Exchange", p. 42).

WAREHOUSE EQUIPMENT AND PROCEDURES. Warehouse facilities were established at Macon in 1945. Material and supplies were shipped to the field from the central warehouse. Concentrate was mixed in 43 gallon batches with a drum type mixer. Three 5,000 gallon storage tanks were placed underground and interconnected for storing DDT solvents. A 250-300 gallon paddle-wheel type concentrate mixer was constructed. In 1947 a 350 gallon elevated concentrate storage tank was provided so that concentrate containers could be filled by gravity flow. This eliminated pump back-pressures and fire hazards and increased the usefulness of the mixer. In 1945 and 1946, concentrate was delivered to field stations in 55 gallon containers. In 1947, one gallon containers were used and proved to be more satisfactory. Vehicle repair facilities were established at the warehouse in May 1946. One mechanic, one welder, and from one to four helpers were employed. In September 1946, these operations were transferred to Cochran Field (about 11 miles south of Macon) to obtain larger repair shop facilities.

APPLICATION RATES. During 1947, with one exception, an application rate of 100-104 mg./sq. ft. of DDT concentrates was used in all counties. Operations were conducted on a basis of two spraying rounds per season, with 10 to 14 weeks between rounds. No applications were made until a contact man had visited



The warehouse in Macon, Georgia.

the homes to instruct the householder in preparing his home for spraying.

OPERATIONS DATA. Weekly summaries of operational reports were prepared at operation headquarters in Macon and promptly distributed to all personnel. These summaries were accompanied by a general memorandum in which the Assistant State Director or the Operations Assistant constructively criticized the week's activities. Operational averages considered significant are summarized in the accompanying table.

RESULTS. In 1946 a poll of health officers, physicians, county officials, and other persons in areas covered by DDT programs, was taken. Results of the poll indicated a decrease in malaria morbidity; diarrhea and enteric diseases (particularly among children); household insects; and family medical care costs. Conversely, general living comfort increased considerably. Informal inquiries revealed similar results in 1947. Distributors of insect spray and malaria medications stated sales were practically eliminated in the program counties. The number of reported malaria cases in Georgia shows a continued trend downward: in 1945, 461; in 1946, 109; and in 1947, only 67.

1948 PLANS. The State Health Department plans to encourage more complete reporting and treatment of malaria cases in 1948. Tentative plans call for a $10.00 payment by the state to every person whose illness is diagnosed as malaria, provided the following conditions are met:

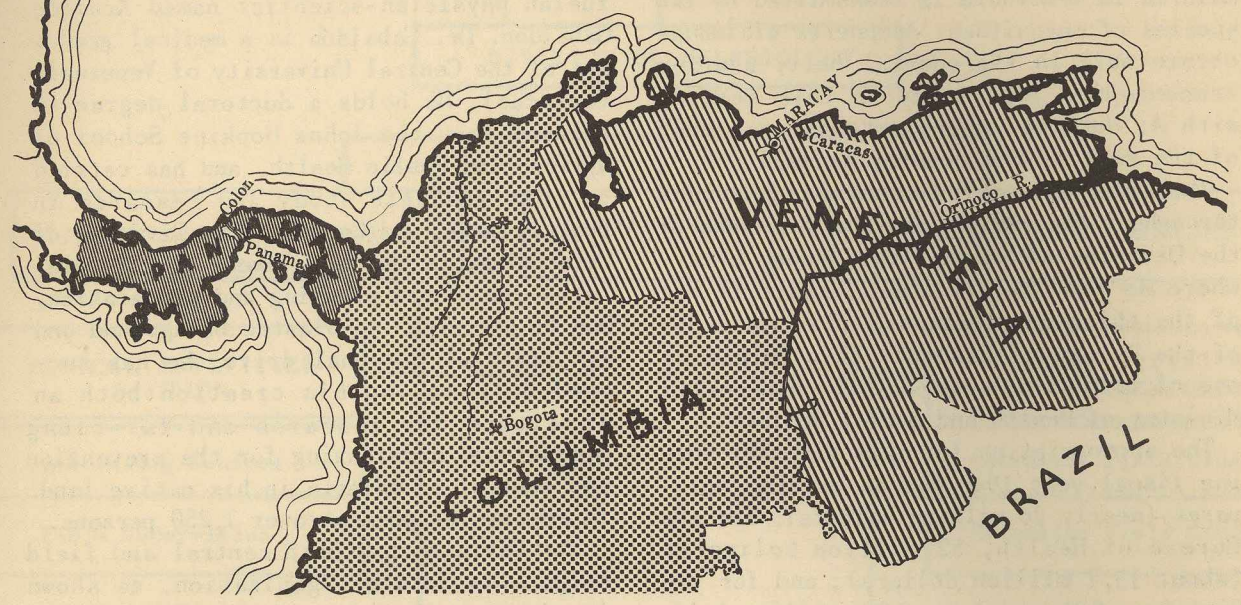
1. The diagnosis is confirmed by a State Health Department blood smear examination.
2. The patient is treated by a licensed physician.
3. The patient is a Georgia resident and the infection is of continental U.S. origin.
4. Full and prompt information is given concerning residence, location, probable infection site, and date.

ITEM	CALENDAR YEAR 1946	FISCAL YEAR 1947	CALENDAR YEAR 1947
Refused percentage (percentage of inhabited homes which were contacted but unsprayed)			23
Spray time percentage (percentage of crew time actually spent at spraying site)			71
Number of county programs	37	52	51
Number of units sprayed	158,639	189,486	218,245
Average gallons of emulsion per unit	2.59	2.62	2.61
Average pounds of DDT per unit	1.23	.85	.78
Av. No. sq. ft. sprayed per unit	3,365	3,405	3,390
Average units sprayed per gross spray crew man-hour	1.19	1.50	1.68
State and local expenditures	$138,774.00	$170,784.00	$194,546.00
USPHS-CDC expenditures	$388,146.00	$338,642.00	$334,207.00
TOTAL EXPENDITURES	$526,920.00	$509,426.00	$528,753.00
State and local cost/unit	$ .87	$ .90	$ .89
USPHS-CDC cost/unit	$ 2.45	$ 1.79	$ 1.53
TOTAL COST/UNIT	$ 3.32	$ 2.69	$ 2.42

SOUTH AMERICAN HEALTH REPORT

OBSERVATIONS AND RECOMMENDATIONS MADE DURING TRIP TO VENEZUELA, COLUMBIA, AND PANAMA SEPTEMBER. 30 TO OCTOBER 29, 1947

By Justin M. Andrews



Dr. Andrews, Scientist Director, Deputy Officer in Charge of CDC, recently reviewed malaria activities in Venezuela, Colombia, and Panama as a representative of the Pan American Sanitary Bureau. His interesting report is presented in its entirety.

A. THE STRUCTURE, FUNCTIONS, AND ACTIVITIES OF THE VENEZUELAN DIVISION OF MALARIOLOGY

The United States of Venezuela in South America is a country of about 326,000 square miles. It lies entirely within the tropics just north of the equator and is divided into approximate halves by the Orinoco River which flows from the southwest to the northeast. Most of the population (4,000,000) lives in the portion northwest of the river. This is divided topographically into coastal, mountainous (Andean) and plains (Llanos) areas. There are twenty states, one federal district, and two federal territories in the country. Venezuela is at present subsisting largely on an oil economy. Oil is the principal, virtually the only, export. Because of the high wages paid by the petroleum industry, agricultural pursuits have declined to the point where it is necessary to import even staple food products. In the hope of reestablishing a better balanced economy, Venezuela is inviting immigration on a huge scale. It is hoped by this means to double the existing population within the next decade. Some 15,000 immigrants, mostly displaced persons from central Europe, Italy and the Balkans, have arrived this year. Whether or not these people will be satisfied to establish a peasant class in rural Venezuela or whether they will compete successfully with native Venezuelans for the more immediately lucrative opportunities provided by the current economy remains to be seen.

Malaria occurs in all the three political subdivisions. During the years 1940 to

1944[1], inclusive, it was reported as being the third, fourth, or fifth cause of death. Since 1943, the mortality and morbidity due to this disease have been declining according to unofficial reports. Most of the malaria in Venezuela is transmitted by two species of mosquitoes. *Anopheles albimanus* occurs only in the coastal belt, sharing transmission importance in this section with *A. darlingi* which extends over most of the rest of the country as well.

Malaria control and investigations throughout the country are the functions of the Division of Malariology, known everywhere as the "Malariología". This is one of the thirteen divisions, or equivalent, of the Bureau of Health[2]. This Bureau is one of five[3] which compose the Venezuelan Ministry of Health and Social Welfare.

The appropriation for this Ministry during fiscal year 1948 was 86 million *bolivares* (nearly 26 million dollars); for the Bureau of Health, 52 million *bolivares* (about 15.7 million dollars); and for the Division of Malariology, 10.4 million *bolivares* (3.1 million dollars). Of this last, 4 million *bolivares* (1.3 million dollars) were appropriated specifically for DDT operations. With the exception of municipal and certain minor state assessments and fees, all the tax revenue in Venezuela is collected by the federal government. About 40 percent of this is made up of a production levy on crude oil. Roughly one-fifth of the total is allocated to the states on a per capita basis and the remainder is used for federal expenditures and for certain direct services, including public health activities, provided for the people by federal agencies. Accordingly, there has been little occasion for states to assist in financing public health. Nevertheless, they have just begun to participate in defraying malaria control costs; during the current year, some of them are contributing 60,000 *bolivares*. Thus the per capita expenditure throughout the country for antimalaria activities is just under 80 cents.

The Malariología is directed by a Venezuelan physician-scientist named Arnoldo Gabaldón. Dr. Gabaldón is a medical graduate of the Central University of Venezuela (Caracas). He holds a doctoral degree in science from the Johns Hopkins School of Hygiene and Public Health, and has carried on post graduate study and research in Italy, France, and Germany. The Division of Malariology is the fulfillment of his carefully considered planning and preparation. Due to his rich scholastic background and his powerful personal drive, he has succeeded in making his creation both an institute for research and far-flung operational undertaking for the prevention and control of malaria in his native land. It employs at present over 1,250 persons.

The Division has both central and field components in its organization, as shown in the accompanying chart. Divisional headquarters are established in Maracay, a city located about 60 miles from Caracas. They are quartered in a building, erected for that purpose, which contains 17,000 square feet. It is about to be enlarged to accommodate additional activities.

The 14 zonal headquarters indicated in the chart cover seventeen of the states and the federal district. In two of the remaining states and in the federal territories, population densities and malaria prevalence are so low that field organizations will not be provided until malaria is reduced significantly throughout the rest of the country. Zones are established along state lines but include more than a single state in some instances. It was planned to staff each zone with a physician and a graduate engineer. Because of the scarcity of such

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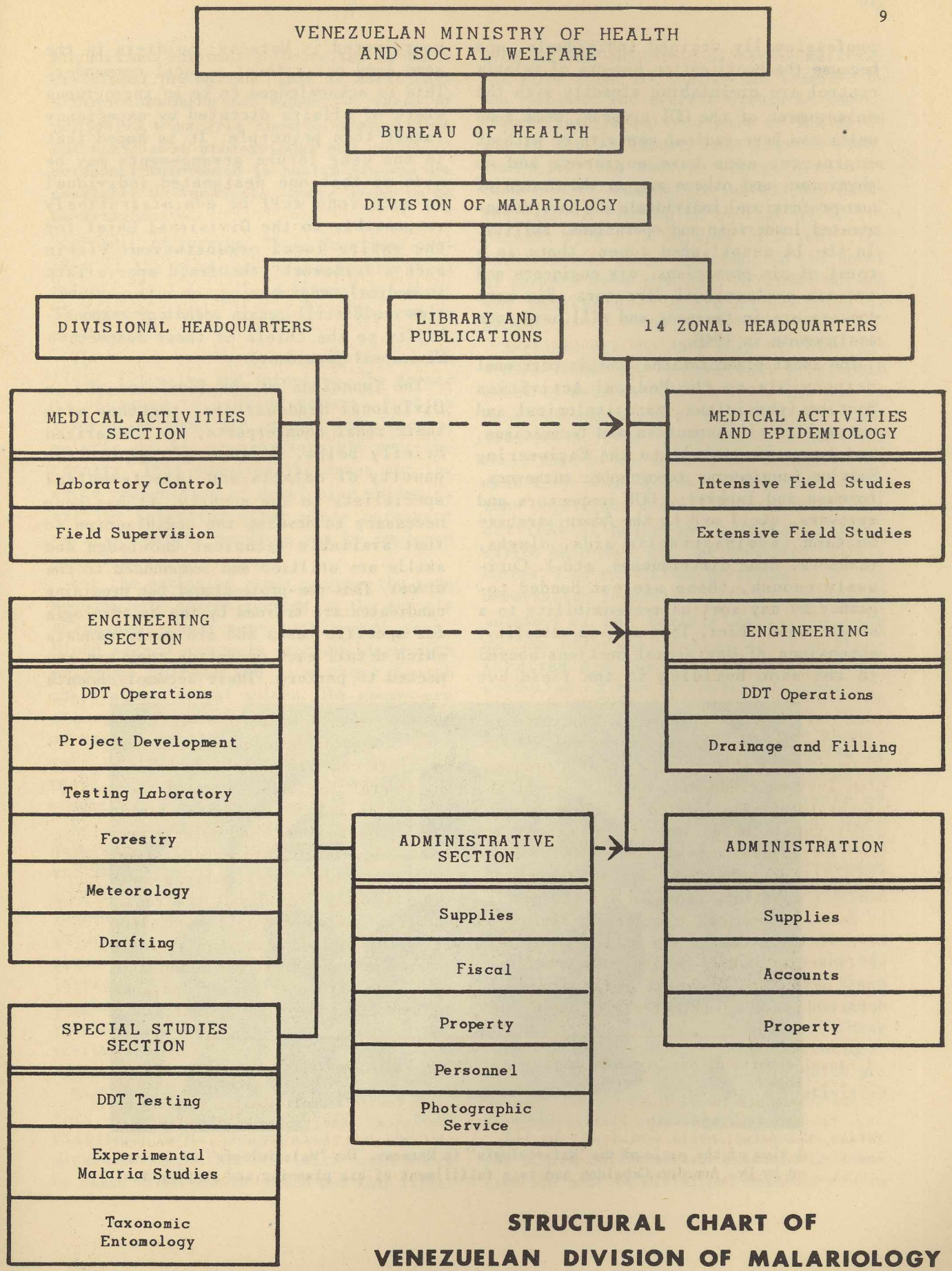
1 Annual reports of the Division of Epidemiology and Vital Statistics for years since 1945 not yet available.

2 The others are Tuberculosis Control; Venereal Disease Control; Health Units; Sanitary Engineering; Epidemiology and Vital Statistics; Health Education; Nutrition and Pharmacy; Maternal, Infant, and School Hygiene; Yellow Fever and Plague Control; Laboratories; Rural Medical Care; and the National Institute of Hygiene.

3 Others are Social Welfare, Administration, Legal Consultation and Cabinet Services.



STRUCTURAL CHART OF VENEZUELAN DIVISION OF MALARIOLOGY

professionally trained individuals, and because the bonification aspects of malaria control are diminishing steadily with the enlargement of the DDT program, some zone units now have medical men with or without engineers, some have engineers and no physician, and others are in the charge of non-professional individuals who have demonstrated leadership and operational ability. In the 14 established zones, there is a total of six physicians, six engineers and two non-professional directors. Six more doctors are in training and will have zone assignments in 1948.

The zonal organizations contain personnel responsible to the Medical Activities Section (physicians, parasitological and entomological inspectors and technicians, and house visitors), to the Engineering Section (engineers, topographic surveyors, foremen and laborers, DDT inspectors and sprayers, etc.) and to the Administrative Section (administrative aids, clerks, cashiers, drug distributors, etc.). Curiously enough, these are not bonded together by any sort of responsibility to a single zonal chief. They are, in actuality, extensions of Divisional Sections housed in the same building in the field but coordinated in Maracay; soldiers in the same army but without a local commander. This is acknowledged to be an incongruous state of affairs dictated by expediency rather than principle. It is hoped that in the near future arrangements may be made so that one designated individual in each zone will be *administratively* responsible to the Divisional Chief for the entire local organization. Within such a framework, the field specialists in medical, engineering, or other activities could still retain *technical* responsibility to the chiefs of their respective Divisional Sections.

The functions of the four sections in Divisional Headquarters, together with their zonal counterparts, are summarized briefly below. Because of the extreme paucity of malaria and insect-control specialists in the country, it has been necessary to develop the organization so that available technical knowledge and skills are utilized and compounded to the utmost. Thus non-professional but promising candidates are trained by the Malariología for specific tasks and are given manuals which detail each operation they are expected to perform. Their accomplishments

A view of the patio of the "Malariología" in Maracay. The "Malariología" is directed by Dr. Arnoldo Gabaldón and is a fulfillment of his planning and preparation.

are checked constantly thereafter by their Divisional preceptors. This is admittedly a time-consuming and expensive means of achieving a malaria control organization but until more professional and technical personnel interested in health careers are available in Venezuela, there seems to be no alternative.

MEDICAL ACTIVITIES. These functions consist of the measurement and treatment of malaria, including field entomology. About 15 percent of the budget is allocated to these purposes.

There are two types of programs in the field, extensive and intensive. The former is designed to provide general routine information about the current prevalence of malaria and its transmitters all over the country. This supplies the means for the early recognition of developing epidemics and for selecting sites where permanent malaria control measures may be employed profitably.

For the extensive study program, the zone doctors make spleen surveys in the schools throughout their zones early each year. Blood smears are made from children with enlarged spleens and from every fourth child with a normal spleen. The smears are stained and examined in the subdivisions of zones, *demarciones,* from which they were collected. During the last three years, an annual average of over 32,000 students has been examined.

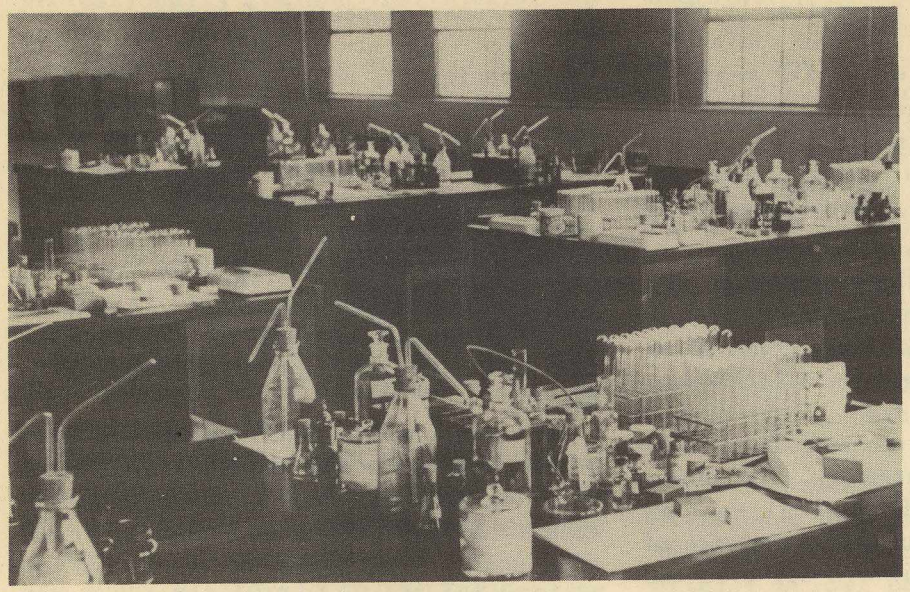
Each demarkation has an *inspector de demarcacion* responsible to the physician and in charge of malaria control medical activities in his area. These demarkation inspectors and their technical aids stain and examine slides, locate and map breeding places from which they identify anopheline larvae to species, and identify captured anopheline adults. During the last three years, the annual number of breeding-place visits averaged over 21,000, adult-station visits over 90,000 per year.

Each demarkation is separated into sectors and in each sector there is a male *visitador rural,* responsible to the demarkation inspector. He visits homes where he makes blood smears (thick and thin films) from persons suspected of having malaria. The thick films are stained and examined by the technicians, usually within 48 hours; thin films are stained only if the thick smears are positive. From 1944 to 1946, inclusive, the average annual number of case-finding home visits was 842,000 which resulted in finding an average of 92,000 persons sick with malaria each year. The rural visitor takes treatment to the homes of persons found positive. He also searches for and captures adult anophelines in houses.

Sections are divided into *circumscriptiones*. These are the smallest geographic units of malaria control influence and in each is located one or more drug distribution posts. From these posts, anyone who feels that he has malaria may obtain treatment free. These posts are selected by the zone physicians and utilize the part-time services of telegraph operators, post-office employees, etc., as treatment distributors. They are visited periodically by the demarkation inspectors but are considered adjuncts of the Administrative Section as the principal divisional functions involved are the procurement and distribution of the antimalarial supplies. Quinine was the standard treatment until 1944 when it was replaced with quinacrine hydrochloride. Some chloroquine is now in use, and may be substituted in the future when the present supply of quinacrine hydrochloride is used. During the last three years, about 524,000 antimalarial treatments were distributed each year, though in 1943 the number was 817,115.

Reports made by rural visitors are combined by demarkation inspectors who add accounts of their own laboratory and field activities and forward these to the zone physician. He consolidates all of these data by states, adding his own observations, and makes monthly state summaries which are sent to the Chief of the Medical Activities Section.

All of the blood films, mosquito larvae and adults collected and examined or idenfied are sent to Divisional headquarters in



A view of a laboratory classroom in the "Malariologiá", Maracay, Venezuela.

Maracay, where samples of each lot (including all positive slides) are checked.

The intensive studies represent an ordered attempt to discover pertinent epidemiologic facts about malaria in different parts of the country. Nine cities known as *estaciones*, representing diverse terrain from the Caribbean coast line to the forests in the south, and from the Orinoco delta region in the east to the Andes in the west, have been selected and are subjected to something more than routine malariological scrutiny. Spleen and blood surveys in schools are made annually by the zone physicians. Slides are stained in the station laboratories. Each station has an *inspector de estación*, with assistants including technicians and *visitadoras urbanas*, girls who make case-finding visits each week to homes in various *distritos* of the station. Blood smears are collected from suspects, mosquito breeding-places are examined at regular intervals, and the numbers of larvae taken per 100 visits are recorded, as are the numbers and species of anopheline adults collected in houses at periodic visits. These data are summarized into monthly reports and are transmitted to the Chief of the Medical Activities Section through the zone physician, who adds epidemiologic comments of his own, if indicated. Their contents are analyzed by the Chief of the Medical Activities Section in considerable detail, correlating them with meteorologic and other environmental influences. Thus a growing volume of basic information is being accumulated interpreting the special epidemiology of Venezuelan malaria in coastal, mountain valley, inland lake, and llanos situations, with respect to different species of transmitters, and under various climatic conditions.

ENGINEERING. This is the most expensive group of activities, requiring some 34 and 39 percent of budgeted funds for the drainage-and-filling program and for the DDT residual spray program, respectively.

Certain functions of the Divisional Engineering Section, such as meteorology and drafting, are obvious. The Testing Laboratory is used mainly to determine and measure characteristics of sand for concrete and of finished concrete structures. The Forestry unit is concerned with: 1) reforestation, mainly with eucalyptus trees, of low, incompletely drained areas; 2) stabilization of open ditch banks with sod and other vegetation; and 3) protection of open ditches from cows, pigs, etc., by thick, thorny hedges planted along each side of the channels.

The two other subsections are the operational anti-anopheline programs. Drainage-and-filling projects are initiated in the Division as the result of conferences based

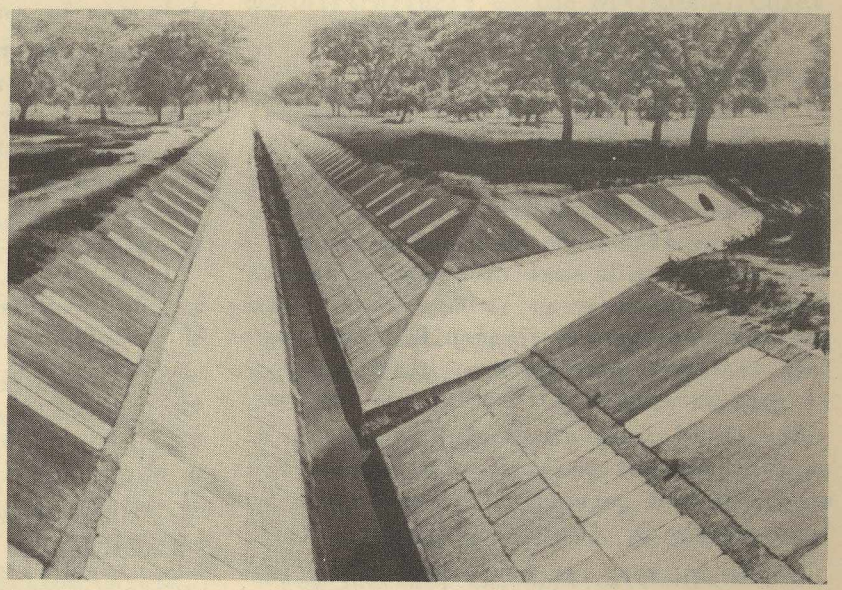
on the clinical, parasitological, and entomological findings of the Medical Activities Section. As far as possible, these projects are restricted to construction and installation of permanent malaria control facilities with low maintenance costs. Each work unit is designed by the zone engineer. Actual field surveys are made by *topografos* within the zone organization. Final plans are sent to the Division for checking and approval. Foremen, laborers, heavy and light equipment, and the necessary materials are assembled and the work proceeds under the supervision of the zone engineer who planned it. Most of the concrete structures are made on or close to the job sites. During the last three years, annual averages of 186,650 concrete structures have been fabricated and 34,890 meters of ditches or canals have been paved.

Present plans are to reduce this activity in the future, limiting it to projects in urban communities where its benefits would be widely distributed and where collateral justification such as sewerage and storm-water drainage exists in addition to malaria control. Some such combination projects have already been completed in cooperation with the ministry of Public Works.

The DDT program consists of the application of wettable DDT in water suspension at the rate of 1 gram/meter (100 mgm/sq.ft.) three times a year to the interior walls and ceilings or roofs of suburban and rural homes in malarious parts of the country. DDT teams, *cuadrillas*, consist of eight men, hand-spraying equipment and a heavy truck with tanks or drums in which to mix the suspension. The trucks, like all the other Malariología vehicles, are painted a conspicuous yellow-orange color, and all the field employees in the DDT service are uniformed in light grey-green two-piece coveralls with DDT shoulder patches indicating rank. The program was started in December 1945. During the following year, 29,013 house sprayings were made, using 17,040 pounds of DDT for the protection of 92,493 persons. This is an application rate of 0.59 pound per house and costs 7.11 *bolivares* ($2.36) per house spraying.

Another element in the DDT program is the preparation and sale by the government of five percent DDT in kerosene. This is mixed and packaged by the Malariología. It is advertised extensively and is distributed and sold all over the country at virtual cost by the Bank for Agriculture and Animal Husbandry for use as a domestic spray.

SPECIAL STUDIES. These represent a cooperative project between the Malariología and the International Health Division of the Rockefeller Foundation. About two percent of the total budget is devoted to their support.



A concrete ditch lining near Maracay, Venezuela. The area of treatment has been expanded from Maracay, first chosen as a proving ground.

The work planned and under way falls into three categories. The first is concerned with the chemical and biological testing of DDT to measure the relative purity and potency of various lots of that material against *A. albimanus* and *A. darlingi*, and

the durability of its insecticidal activity on different types of surfaces such as adobe, plaster, wattle-and-daub, and the fine and coarse plants used for thatching houses. Some of these observations are being made on blocks of test substances which can be subjected to various environmental influences and assayed biologically whenever desired. Comparable determinations on a larger scale will be made on the walls and other surfaces within inhabited and uninhabited houses.

New insectary facilities are being constructed to supply the biological material for the testing experiments and to study the bionomics and behavior of the vectorial species.

The second type of study consists of field observations of the effect of single annual sprayings in selected *darlingi* and *albimanus* villages which will be contrasted with that of two or more applications per year in other comparable communities to see whether the same or different patterns of DDT application should be used against these two species of anophelines. It is also planned to study and appraise the influence of DDT house spraying on the general health and welfare of the inhabitants of certain small Venezuelan towns.

As time permits, it is hoped to survey the blood protozoa of local birds, reptiles, bats, and other possible hosts for *Plasmodium* or related genera.

The third class of special studies is a continuation of the taxonomic antomology which has been carried on for some years in Venezuela by Dr. Pable Cova-Garcia.

ADMINISTRATIVE. About 10 percent of the budget is required for these activities. In the field, the functions of ordering supplies, handling payrolls, and accounting for property are discharged by administrative aides and clerks. Comparable activities, including personnel actions, are performed by the Administrative Section which also contains the photographic unit.

The Division appears to have considerable freedom in the recruiting, placement, classification, and movement of personnel. On the other hand, it suffers great delays and inefficiencies, resulting from the present necessity of procuring supplies through a highly centralized governmental purchasing agency. These difficulties are, of course, greatly augmented by the fact that most of the equipment and materials have to be imported.

Except for petty items, direct purchasing by the Malariología is not permitted. All that the Divisional Administrative Section can do is transmit to the Ministry of Health specifications for items desired and indicate agents from whom they may be procured. The administrative unit within the Ministry obtains bids, makes purchasing arrangements, and prepares the purchase orders. These must then be preaudited and approved in the Comptroller General's Office, at which level it is not uncommon to have negotiations reopened with local agents or with sales agencies abroad, thus delaying by months the arrival of items which may be critical for continued operations. Authorization for the Malariología to make direct purchases, at least of standard materials and equipment, subject to post-audit, would undoubtedly improve the efficiency and probably reduce the cost of malaria control activities.

It is the fiscal practice in the Venezuelan Government to make funds available on a monthly basis in equal sums throughout the year. While this routine is undoubtedly satisfactory for many departments and agencies, it is very difficult for units in which activities are as highly seasonal as malaria control to meet their obligations promptly and adequately, or to take advantage of occasional but profitable opportunities to buy at bargain rates. If funds could be transferred to the Malariología in accordance with seasonal needs, additional economies might be effected.

In summary, it may be said that Dr. Gabaldón has established an effective organization which is giving essential malaria-control service to the citizens of Venezuela. It is flexible enough to adapt easily to a DDT program which is planned to become country-wide in its application. Between the DDT and the free antimalarial

treatments, it is probable that malaria will be reduced to a very low prevalence and in time may be extinguished completely in certain places. Indeed, it is not unlikely that, in certain biological islands such as some of the mountain valleys, the vectors of malaria may be eradicated. There appears to be no reason why the primary malaria control objective of the Malariología cannot be expanded in time to include the control of all domestic insects and rodents and the diseases of man which they transmit. This would presumably achieve such collateral health benefits as reduction of enteric infections, especially in the very young, Chagas' disease, murine typhus, filariasis, sandfly fever, leishmaniasis, and possibly other maladies the transmission of which by insects or arthropods is not now recognized.

RECOMMENDATIONS

The following suggestions are made with the view of improving the efficiency and effectiveness of Venezuelan malaria control operations in general, and of DDT service in particular:

1. Responsible Divisional personnel, especially Section Chiefs, should make frequent visits into the field to observe: 1) the collection of exploratory, inspectorial, and evaluative data, and 2) operational procedures.

Members of the field staff can not have the perspective of divisional headquarters personnel. They may unknowingly drift into or permit substandard practices to develop, the inferiority of which is immediately apparent to persons familiar with the programs in all zones. Corrections and constructive suggestions should be made to the ranking zone representative who should transmit them to his own subordinates.

The field is a fertile territory for the development of new methods and ideas. Such improvements should be considered carefully by Section Chiefs, and, if meritorious, be transmitted to and demonstrated before personnel in other zones.

2. If and when such arrangements can be made, it would seem desirable to establish one designated individual as chief or director for each zone, to be responsible *administratively* to the Divisional Chief for the entire zonal organization. Within such a framework, the field representatives of medical, engineering, or other activities would still obtain technical direction from the Chiefs of their respective Divisional Sections.

3. In the opinion of the author, the DDT program may be improved as indicated below. Wide-scale operational changes should not, of course, be undertaken until adequate field testing under local conditions has established their desirability.

a) Change from DDT suspension to DDT emulsion, unless the cost differential (including savings on labor and equipment maintenance) is prohibitive.[1]

b) Increase the application rate from

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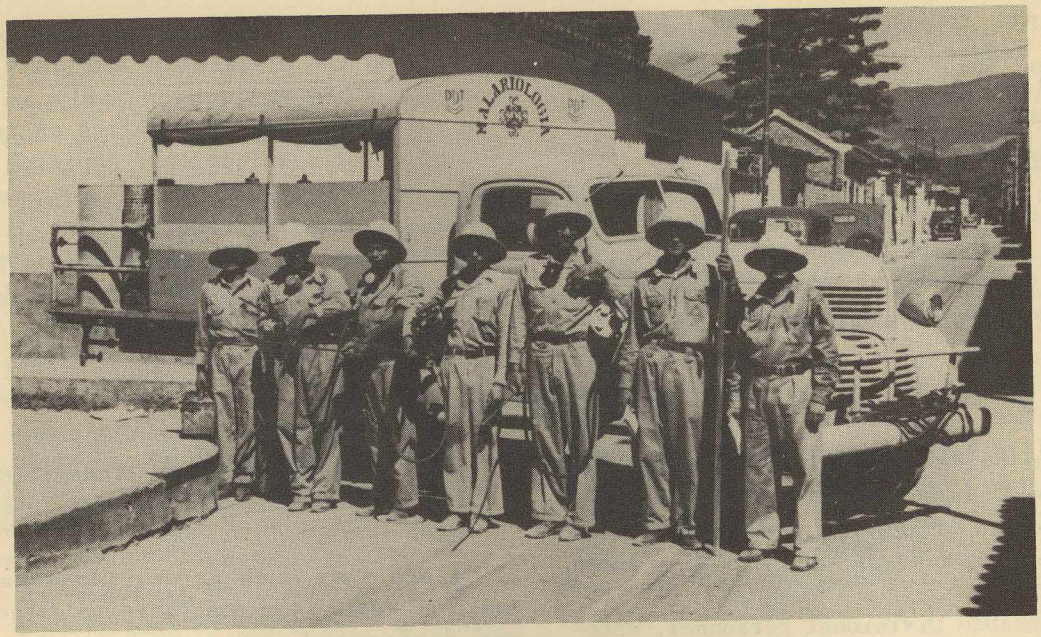
[1]This recommendation was based upon (a) the uncertain efficiency and excessive maintenance and replacement costs for handspray equipment as used in Venezuela for applying wettable DDT, plus (b) the presumption, based on insufficient study, that there was no significant difference in the insecticidal effectiveness and durability of emulsified and suspended DDT. Since then, more technological evidence bearing on this point has been published from other countries indicating that the residual efficiency of wettable DDT definitely surpasses that of emulsions or solutions of DDT on earthen walls. In view of this more recent information, experiments should be made in Venezuela to assess the comparative insecticidal properties of these two forms of DDT under local conditions. Such investigations are now in progress. If it is determined that water-wettable DDT is best adapted for the needs of the country, the next developments should be to obtain spray equipment more suitable for its application.-J.M.A.



A Venezuelan DDT spraying crew and truck.

one to two grams per square meter. If the spraying is to be done only for malaria-control purposes, it should be possible to reduce the number of sprays per year from three to two, the first of which should come at the end of the dry season, and the second approximately four months later. If the program is expanded for the destruction of *all* household insects, a third spraying at the same application rate should be added four months after the second.

c) It is believed that smaller crews of two or three sprayers could operate more efficiently than the present crews of six sprayers where houses are greatly dispersed. It is suggested, therefore, that studies be made in each of the zones to determine the amount of terrain which could be served most efficiently 1) by the larger crews carried in heavier trucks, and 2) by smaller crews carried in lighter trucks. It would then be possible to place an order for small but substantial vehicles, and organize itineraries for each type of truck.

d) All trucks should be equipped with functional air compressors and tanks so that spray cans may be charged with compressed air from the tanks, rather than by hand pumping.

e) Tanks for holding and mixing DDT emulsion should be installed permamently in the trucks. Drums of 55-gallon capacity constitute a good makeshift, but are now expensive and hard to obtain. It seems likely that substantial metal tanks with less waste space than drums could be fabricated locally and installed in the trucks.

f) Motor-driven water pumps should be installed on all trucks, plumbed to the DDT tanks, and equipped with sufficient inlet hose so that water may be pumped from a natural source directly into the tanks without the use of hand labor. These could also be rigged for mixing DDT with water if desired.

g) Extra spray nozzles should be carried by each sprayer. He should not be allowed to clean nozzles with metal probes. Wooden ones (toothpicks) will do the job as well, and will not deform or enlarge the nozzle aperture.

Pending the arrival of more nozzles, the operation of many now on hand could be improved by filling the present aperture with brazing metal and reboring and shaping a new one.

h) Spray cans should be equipped with inlet extensions so that they cannot be filled with DDT mixtures beyond two-thirds capacity.

4. It is believed that the present anti-anopheline DDT program should be extended to a complete domestic insecticidal program. As malaria prevalence decreases, interest in and budgetary support for continued malaria operations will decline. If the objectives of DDT service were redefined to include the control of all domestic insects, this would diminish the number of household pests and insure collateral health benefits in reduction of enteric infections, Chagas' disease, filariasis, sandfly fever, leishmaniasis, and possibly other maladies the transmission of which by arthropods is not now recognized. If and when such a program is realized, it would seem logical to consolidate the Division of Yellow Fever and Plague Control with the Division of Malariology.

5. Prints of aerial photographs taken for any government agency should be made available at cost to the Division of Malariology for mapping purposes.

6. It would be desirable to have fiscal allowances transferred to the Malariología according to its seasonal needs, rather than on a parity monthly basis. The expenses of operational programs which are as seasonal as malaria control require more funds during certain months than others.

7. It is highly desirable that the Malariología be authorized to make direct purchases of standard items used recurrently in the operational programs, subject to post-audit. The uncertainties and delays inherent in the activities of any distant and unrelated purchasing agency, together with the pre-auditing practice, are inconsistent with the most efficient conduct of large operational programs.

B. OBSERVATIONS IN COLOMBIA

The Institute de Estudios Especiales "Carlos Finlay" is located in Bogota and was founded in 1935 by the International Health Division of the Rockefeller Foundation to provide facilities for the study of yellow fever problems in northern South America. Past directors and investigators have included the following members of the International Health Division: Drs. George Bevier, John Bugher, Charles R. Anderson, Hugh Smith, Henry Kumm, John R. Paul, Rolla D. Hill and Austin Kerr. The present director is Dr. John E. Elmendorf and he is assisted by Dr. Augusto Gast-Galvis, Pathologist, and Dr. Manuel Roca-Garcia, Vaccine Specialist.

The laboratory produces yellow fever vaccine for use in the vaccination campaign against yellow fever in Colombia. From 1937 to May 1, 1947, 1,120,000 persons have been vaccinated in this country. Vaccine produced in this laboratory is also distributed free to the neighboring countries with actual or potential yellow fever problems (Equador, Peru, Venezuela, Panama, Cuba, Dominican Republic, Haiti, British Guiana, and Curacao).

As a diagnostic element in the yellow fever control program, a viscerotomy service has been established throughout the country. This includes some 200 posts

equipped to obtain specimens of liver from cadavers of persons dying with unrecognized types of fevers. These specimens of liver are fixed, sectioned and examined histopathologically at the Institute with the object of determining whether or not yellow fever or some other disease diagnosable from liver sections was the cause of death. Thus, it has been possible to confirm rapidly the presence of yellow fever outbreaks — sylvatic or urban — before epidemics get under way. Furthermore, by means of this viscerotomy service there have been discovered in Colombia cases of visceral leishmaniasis and histoplasmosis which previously have not been known to occur in that country. Since the Institute was established, no cases of urban yellow fever have been reported except for a few cases at Buena Vista on the Magdalena River (reported about 1947). Some 20,000 liver specimens have been examined from Colombia and other South American countries.

The laboratory is also making investigations on the medical entomology of yellow fever and studies upon immunity contributing to knowledge of the spread of yellow fever, and is attempting to discover the duration of vaccine protection.

A continuation of present activities is planned for the future. In addition, it is hoped to undertake studies of rickettsial diseases, principally typhus and spotted-fever, and other diseases caused by viruses. It is planned to produce vaccine against typhus and spotted-fever. Special studies will be made in pathology in relation to public health.

The Instituto de Estudios Especiales "Carlos Finlay" is being consolidated with the Samper Martinez National Institute de Hygiene; both buildings are located in the same block. The Carlos Finlay Institute will constitute the Sections on Pathology and Medical Entomology of the larger National Institute of Hygiene.

Yellow Fever is a disease which seems removed, unreal, and not especially important to many American public health scientists. Nevertheless, as of October 17, 1947, 56 fatal cases of yellow fever had been diagnosed in Colombia that year. That is not the complete total of deaths due to this disease as viscerotomy coverage is incomplete and imperfect.

For the past 15 years, all yellow fever cases in Colombia have occurred in isolated forest areas, principally sparsely populated regions. Occasionally a yellow fever patient is able to reach town before he dies or recovers and, since *Aedes aegypti* occurs in many towns in certain regions, the threat of urban epidemics is ever-present. One of the arguments for getting rid of *Aedes aegypti* in South America is that there are large parts of the continent where the species has never arrived. One of these areas is the entire eastern slope of the Andes and the llanos in Colombia. *Aedes aegypti* has never been found in Villavicencio or Acacias (a town from which many cases of yellow fever are currently reported) but, with constantly improving means of transportation, the species will arrive in these areas sooner or later unless eradication is completed. It is probably because many of the areas are without *Aedes aegypti* that urban outbreaks have not been more frequent in those areas where jungle yellow fever has occurred. Vaccination is the only known means of preventing this disease at present so it must be continued on a large scale until some better method is found.

There is an important international aspect to the yellow fever problem. Yellow fever is one of the diseases that travels well in ships and probably even better in airplanes. The disease accompanied sailing ships that carried water in barrels and tanks which were left open so that *Aedes aegypti* could breed freely throughout the voyage. Although ships today are less vulnerable, the airplane carries the infected case through to any destination in less than the maximum incubation period of yellow fever. Every effort is made in South American countries where yellow fever is a potential problem to prevent the extension of this deadly disease from jungle situations to cities and especially to seaports and airports. Large-scale eradication

programs are in effect in all South American countries where the disease occurs. An agreement has been negotiated by Colombia with Brazil and Peru to the effect that all three countries will enlarge their campaigns against this disease. Due to the research of the International Health Division personnel and their associates in Brazil and present activities are concerned with describing species in terms of functional rather than morphological differences, using anopheline mosquitoes. There are 23 species of *Anopheles* in the area. Dr. Bates is of the opinion that anatomic differentiations are the reflections of environmental adaptations. Studies are

This Venezuelan worker is stencilling the date of DDT application on the wall of a house.

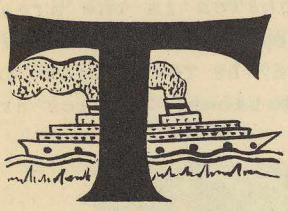
Colombia, it is now known that yellow fever is reservoired principally in aboreal primates, principally marmosets, and possibly marsupials from which it is transmitted in nature by various species of *Haemogogus* mosquitoes. It occasionally reaches man when wood-cutters or cacao gatherers or others working in wooded situations are bitten by these mosquitoes.

The Villavicencio Field Laboratory of the International Health Division of the Rockefeller foundation is directed by Dr. Marston Bates and was established in 1934 to conduct special studies in conjunction with the Carlos Finlay Institute on the reservoirs and transmitters of jungle (sylvan) yellow fever in northern South America. This work has now been discontinued. The now in progress describing the physiologic rhythms of anopheline species, e.g., rate of growth and moulting, time of day of moulting or pupation, etc.

The Laboratory is a series of one-story buildings with insectaries above and under ground, animal cages and laboratory-offices. Dr. Julian Zulueta of Madrid, Spain, is working on mosquitoes with one or two helpers under the supervision of Dr. Bates.

Dr. Bates is just finishing a book to be entitled. "The Natural History of Mosquitoes", but his wife, Nancy Bell Bates, has beaten him to the market with her report of life in the llanos, entitled "East of the Andes and West of Nowhere".

C. OBSERVATIONS IN PANAMA



he Gorgas Memorial Laboratory is the research component of the Gorgas Memorial Institute, the administrative headquarters of which are located in Washington, D. C. The Laboratory is situated in the city of Panama, R.P., and operates at present a single field station known as the Juan Mina Station. This last provides field facilities for certain mosquito and malaria studies in the Chagres River area.

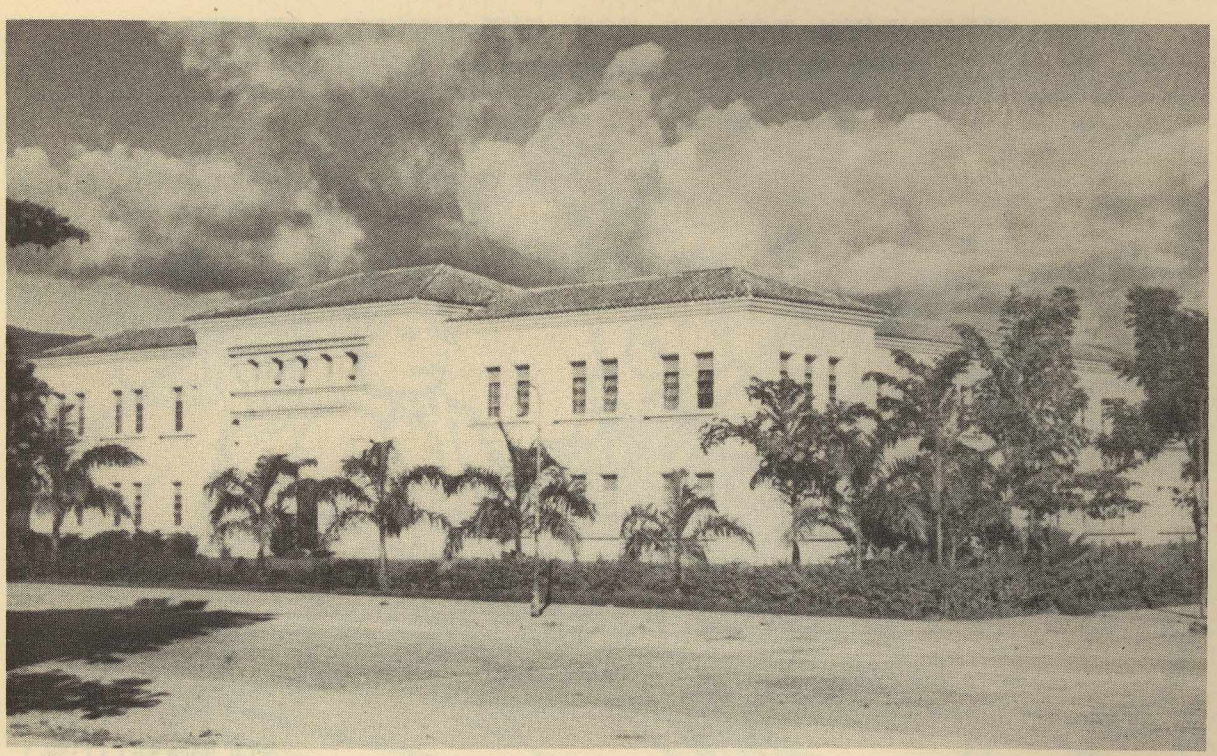
The full-time scientific staff of the Gorgas Memorial Laboratory consists of Dr. Herbert C. Clark, Director; Major Marshall Hertig, Sn.C., AUS, Investigator; Dr. Graham Fairchild, Investigator; and Dr. Harold Trapido, Biologist (absent on a Rockefeller Foundation-sponsored trip to Colombia and Venezuela when Laboratory was visited). In addition, Srs. Pedro Galindo and Marcelo Gallardo, members of the Compaña Antimalarica of the Panamanian Government, have part-time appointments with the Laboratory.

The activities of the Laboratory for many years have been concerned with research on diseases effecting man and animals in the American tropics. Dr. Clark is interested primarily in practicable types of malaria control which will enhance the physical effectiveness of tropical labor. For some 17 years, he and Colonel W. H. W. Komp of the USPHS have been evaluating standard antimalarial drugs (quinine, atabrine and plasmochin) for this purpose. These observations have been made on the inhabitants of isolated villages situated on the banks of the Chagres River. In general, the practice has been to make monthly blood surveys and to provide parasite positives with courses of treatment of one or another or a combination of these drugs. Present conclusions are that, used according to the conditions of this study, these drugs reduce malaria morbidity to a marked degree but hold no promise of malaria eradication and probably do not interfere significantly in the transmission of the disease. During the FY 1945, Dr. Trapido commenced spraying certain of these villages with residual DDT. He succeeded in reducing the domestic mosquito population *(Anopheles albimanus)* in a single season to the point where transmission — as measured by monthly blood positives — was lower than it had ever been in the past by treatment, though it had not been eradicated. Present plans are to stop or reduce drug treatment in all these villages and to substitute residual DDT house spraying.

With the advent of chloroquine and paludrine, Dr. Clark has commenced some new 12-month experiments with drug control on the inhabitants of isolated villages on the shores of Gatun Lake. These involve the distribution of suppressive doses to every resident each week and blood surveys each two or three months. In some instances, the villages are also sprayed with DDT. These observations have been in progress since the first of this calendar year but are much more promising not only from the standpoint of reducing morbidity but of diminishing parasitemia and preventing transmission as well. Of the two drugs, chloroquine seems to be the more efficient.

Major Hertig and Dr. Fairchild work almost exclusively on sandflies of the genus *Phlebotomus*. Their taxonomic activities have produced many revised and improved descriptions of old species and accounts of new ones. Operationally, they have shown that relatively minute quantities of residual DDT placed on sandfly breeding places and within the walls of houses reduce the sandfly population virtually to the point of extinction.

In addition to his malaria interest, Dr. Trapido, who has a broad biological background, has been making investigations



This fine, white-stone laboratory and office building is the "Malariología" in Maracay, Venezuela.

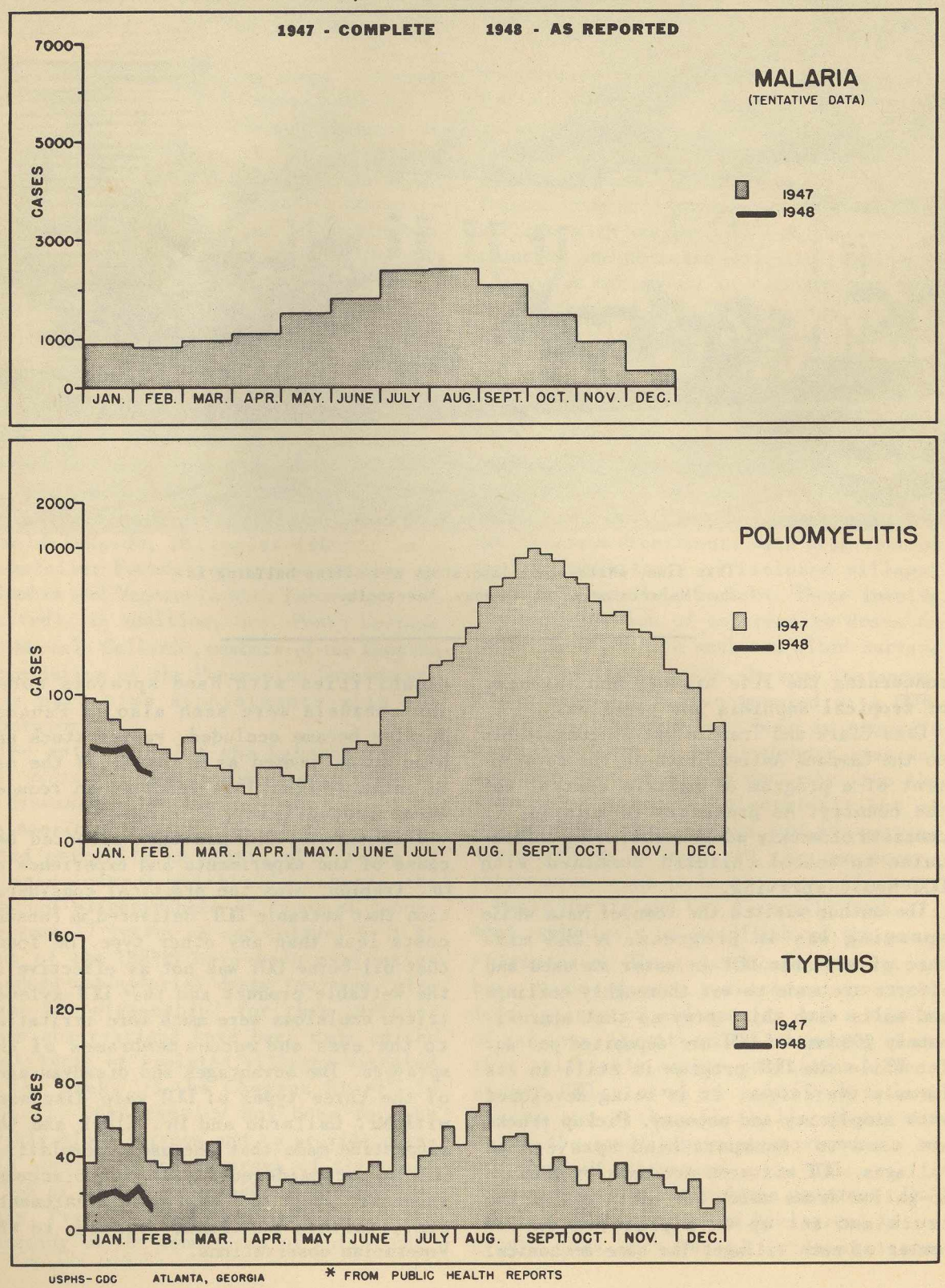
concerning the life history and taxonomy of tropical amphibia and reptiles.

Drs. Clark and Trapido act as consultants to the Campana Antimalarica in the development of a program of malaria control for the country. As presently formulated, it consists of weekly administration of chloroquine to school childred combined with DDT house-spraying.

The author visited the town of Nata while spraying was in progress. A 2½% mixture of wettable DDT in water is used and efforts are made to wet thoroughly ceilings and walls with this spray so that approximately 200 mm. of DDT are deposited per sq. ft. While the DDT program is still in its formulative stages, it is being developed with simplicity and economy. Pickup trucks are used to transport hand sprayers to villages. DDT mixtures are made by hand in 55-gallon drums which are taken out of the truck and set up on a platform in the center of each village. The same mechanical disabilities with hand sprayers noted in Venezuela were seen also in Panama. Nozzles became occluded, valves stuck and hand pumps jammed as a result of the use of wettable DDT. This resulted in reduced labor productivity.

This form of DDT has been selected because of the experiments and experience of Dr. Trapido, plus the practical consideration that wettable DDT, delivered in Panama, costs less than any other type. He found that oil-borne DDT was not as effective as the wettable product and that DDT-xylene-triton emulsions were much more irritating to the eyes and mucous membrames of the sprayers. The advantages and disadvantages of the three types of DDT were discussed with Mr. Gallardo and Dr. Clark and the suggestion made that the use of emulsified DDT be reconsidered, taking into account excessive labor and equipment maintenance cost, factors mentioned relative to the Venezuelan observations.

MORBIDITY TOTALS FOR THE UNITED STATES*
MALARIA, POLIOMYELITIS, TYPHUS



USPHS-CDC ATLANTA, GEORGIA * FROM PUBLIC HEALTH REPORTS

DIVISION REPORTS

Epidemiology Division

VIRUS BRANCH PERSONNEL TO ATLANTA

The decision was made to transfer the Virus Branch from Montgomery to Atlanta on or before June 1, 1948.

STATISTICAL BRANCH

Current recording of cases received from the Office of the Surgeon General on malaria, typhus fever, and poliomyelitis was continued.

MALARIA. Reports, charts, and maps on malaria morbidity and mortality were prepared for administrative purposes.

TYPHUS FEVER. Certain phases of typhus fever morbidity for 1944-1947 were analyzed and evaluated, statistical assistance was given to the evaluation of data from field control programs, and statistical consultation was provided to the Typhus Investigations Project at Thomasville, Georgia.

POLIOMYELITIS. Current reports of poliomyelitis were plotted by states and epidemicity evaluated by control chart methods. Evaluation of data collected in the Wilmington, Delaware poliomyelitis experience was continued. Studies of epidemics in the United States for 1947 were initiated.

Data of the National Office of Vital Statistics on diarrheal diseases were processed for administrative purposes. Statistical consultation was given on problems of tabulation, analysis, and evaluation of human experience, cases and laboratory results of the Dysentery Control Project, Pharr, Texas.

Services were also provided to the Georgia and South Carolina Boards of Health and to four CDC divisions.

VIRUS BRANCH

30% DDT INSECTICIDE USED IN LOUISIANA. The airplane spraying of DDT in the vicinity of New Orleans was completed during the quarter. Spraying was performed

under the direction of Major T. E. McNeel, and Major Stephens of the District No. 4 office to reduce mosquito and fly prevalence in partially inundated areas in the wake of the recent hurricane. The insecticide used was 30% DDT in Velsicol NR-70 applied at the rate of 0.3 pound of DDT per acre. Thus, adult fly control and mosquito control were obtained. Wing sprays were used in unpopulated areas; aerosols in housing areas. Despite unfavorable high winds, excellent results were reported by locally supplied inspectors. Jefferson, an area in northwestern New Orleans, and Chalmette, a settlement east of New Orleans, were the principal areas treated.

ENCEPHALITIS SERA OBTAINED IN TENNESSEE. Assistant Surgeon Lindsay K. Bishop and Assistant Surgeon (R) Ralph S. Paffenbarger revisited the middle Tennessee encephalitis area in October. Convalescent sera and acute sera on a few new cases were acquired. The Pediatric Department of Vanderbilt University agreed to obtain repeat serum samples on any cases returning to the hospital clinic. The first lot of these sera was received in December. Results of neutralization tests are not yet available. Most of the encephalitis cases were hospitalized at either Vanderbilt or Nashville General Hospitals, both under Vanderbilt University administration.

ENCEPHALITIS PROJECT IN LaFAYETTE, LOUISIANA. Two return trips to the Louisiana encephalitis area were made. Several additional human cases were followed up with contact and environmental studies. An arrangement was made with refuge managers to obtain a significant number of wild fowl bloods for neutralization tests so that the incidence of this disease in Louisiana can be clarified. A few bird bloods have already been received but numbers are inadequate. This emphasizes the need in the Virus Branch for a biologist qualified to perform ornithological studies. Most investigators believe wild birds comprise the greater reservoir of encephalitis viruses.

Plans have been completed for transmission studies using various insect vectors suspected of transmitting encephalitis. An insectary room is now under construction for this purpose. Lice and mites were collected from Louisiana in November for encephalomyelitis studies.

Neotropical Species Trapped in Louisiana. Taxonomic studies were continued on flies collected in LaFayette, Louisiana in October. Identification of them was completed. Four traps were run for 2½ days at each of four sites east of the city limits in the general vicinity of the city dump. *Musca domestica, Phaenicia pallescens, Phaenicia sericata,* and *Callitroga macellaria* were the most abundant species found. The most surprising result was the appearance of the neotropical species, *Sarcophaga austrailis* in large numbers in the roadside trap and its complete absence in the other traps.

POLIOMYELITIS APPEARS LATE IN NORTH CAROLINA. Assistant Surgeon (R) Ralph S. Paffenbarger visited Thomasville, N.C., to investigate a late season poliomyelitis epidemic. Over thirty patients were examined in two isolation hospitals in that area. Blood, stool, and nasopharyngeal specimens were collected for further laboratory investigation. All patients examined presented a picture compatible with the diagnosis of poliomyelitis. Laboratory studies substantiated this opinion when two stool specimens employed in monkey inoculation proved to contain poliomyelitis virus.

A comprehensive final report on the Wilmington, Delaware poliomyelitis experience is in preparation.

DETERMINATION OF *PHAENICIA* IN HIDALGO COUNTY, TEXAS. A total of 75 collections from nine localities in Hidalgo County, Texas was sent from the Dysentery Control project to the Virus Branch, Montgomery, for identification. It was found that *Phaenicia sericata* is the most common member of the genus in the Hidalgo County area. *Phaenicia caeruleiviridis,* a rural species common throughout the southeastern states, is almost completely replaced by the neotropical species, *Phaenicia eximia.*

Texas Flies. A total of 1,158 *Sarcophagidae* from Pharr, Texas, representing 35 species, was determined. It is likely that a number of species found last year during the Pharr dysentery project will prove to be new to science. About 1,200 specimens were mounted and labeled.

TYPHUS INVESTIGATIONS AT THOMASVILLE, GEORGIA. The effectiveness of murine typhus fever control methods (particularly DDT dusting) continued to be tested. The methods were tested for their effect on human incidence of murine typhus fever, rat (reservoir) prevalence of murine typhus, and abundance of various rat ectoparasites (potential vectors).

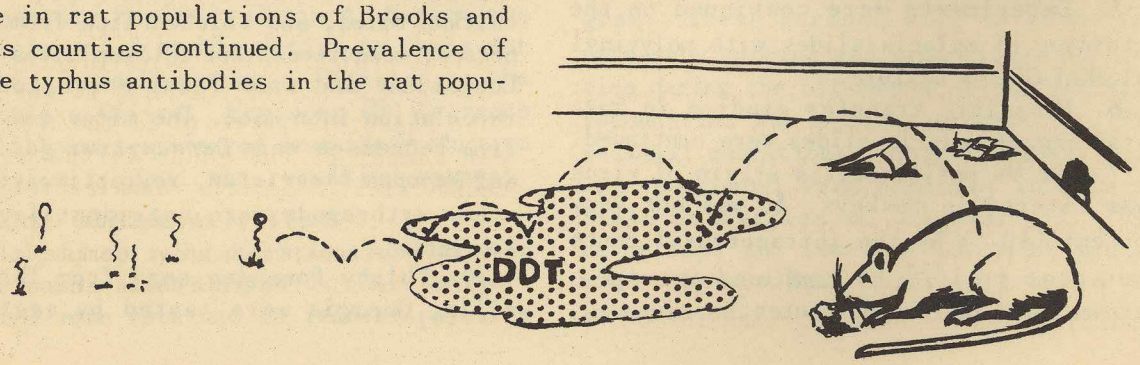
Human Incidence Studies. Tables showing occurrence of murine typhus in humans show a mathematically significant decrease for the eighteen month period following the beginning of control operations as compared with the eighteen month period prior to July 1, 1946. This is true for Brooks, Decatur, and Thomas counties. A slight increase was noted for the check county, Grady, where no control treatments have been applied. In Brooks, Thomas, and Decatur counties, human cases showed a sharp decline in 1946 as compared with 1945. Grady showed a slight increase. During 1947, there was a continued decline in human cases in Brooks, Decatur, and Thomas counties. The decline was more marked in Brooks and Thomas counties than in Decatur county. Decatur showed about the same ratio of decrease as occurred in Grady where the decline was probably a normal one.

Reservoir and Vector Studies. The downward trend of murine typhus antibody prevalence in rat populations of Brooks and Thomas counties continued. Prevalence of murine typhus antibodies in the rat population of Grady county has remained at a fairly high level.

Four species of ectoparasites represent over 95% of those collected from domestic rats in this area. They are *Xenopsylla cheopis* and *Leptopsylla segnis, Liponyssys bacoti,* and *Polyplax spinulosa. X. cheopis* and *L. segnis* seem to have been fairly well controlled, on a county-wide basis, in Brooks and Thomas following DDT dusting operations. There may have been some suppression of *L. bacoti* and a very slight decrease in *P. spinulosa* in these two dusted counties.

Murine Typhus Fever Decrease Credited to DDT. Decrease in human cases of murine typhus fever in Brooks and Thomas counties can probably be credited to DDT. The reduction in rat fleas is probably the most outstanding feature in this change. Perhaps minor effects upon other rat ectoparasites are sufficient to disturb the chain of events which results in the maintenance of murine typhus in the rodent reservoir. Potential DDT rat killing power may be sufficient to reduce the potentialities of typhus transmission within the reservoir to man.

Although the major cause of the decrease in human typhus in Decatur county is in doubt (due to two programs conducted in this county in 1946 and 1947: rat poisoning and DDT spraying) the over-all populations of ectoparasites were not materially affected. Rat trapping cannot be credited with causing the gross epidemiological changes noted in Brooks, Thomas, and Decatur counties. DDT dusting operations are still credited with causing a downward trend of murine typhus incidence.



Laboratory Division

LABORATORY TRAINING COURSES

Twenty-three students attended the ninth six-weeks course in the "Laboratory Diagnosis of Parasitic Diseases" held October 6 — November 14, 1947. Recruitment for the tenth course in this subject (January 12 — February 20, 1948) resulted in 23 applications from 16 states, Puerto Rico and Canada. Recruitment was started for the second course in "Laboratory Diagnosis of Parasitic Diseases" for laboratory directors and physicians (March 8 — 19, 1948). Two laboratorians from the Massachusetts State Public Health Laboratory and Emory University were given a six-weeks training course in the "Laboratory Diagnosis of Tuberculosis". A five-weeks course in this subject was planned for April 5 — May 7, 1948 for seven persons.

LABORATORY INVESTIGATIONS

1. Work was continued on the effect of pyocyanin (and other products extracted from *Pseudomonas serogenosa* cultures) on the growth of flagellates in culture. The flagellates used: *Trypanosoma cruzi* and *Trichomonas foetus*.

2. Deterioration studies on the polyvinyl alcohol-fixative technique were continued.

3. Studies of the effect of deep-freezing on stool specimens containing helminth material were begun.

4. Lymph nodes excised from a patient with kala-azar were embedded, sectioned and stained in various ways to determine the method of choice in slide preparation for laboratory classes.

5. Experiments were continued on the staining of malaria slides with polyvinyl alcohol-Giemsa mixture.

6. Parasitic transfer studies in mass staining of malaria slides were continued.

7. The MV poliomyelitis strain of virus was titered in monkeys. It was not very potent (10^{-1}) by the intracerebral route but went to 10^{-3} by combined intraperitoneal and intranasal routes.

REFERENCE DIAGNOSTIC SERVICES

During the quarter the following diagnostic services were rendered:

1. 2,028 miscellaneous diagnostic tests were performed for state, local or private laboratories.

2. 2,171 malaria survey slides were examined.

3. 494 specimens from the Emory University Field Station and Manning, S.C. were tested in connection with host preference serology studies.

4. 9,992 complement-fixation tests for rickettsial diseases were performed.

5. No virus was recovered from any of the fecal specimens inoculated into monkeys from 17 different individuals in Wilmington, Delaware.

6. Fecal material from two cases of poliomyelitis occurring in Thomasville, North Carolina in December 1947 was inoculated into monkeys. These monkeys developed typical clinical and pathological poliomyelitis.

7. Autopsy material from four humans and three horses from Louisiana was inoculated into mice and guinea pigs. The virus of Eastern Equine Encephalomyelitis was obtained from two horses and was identified by neutralization tests in mice.

8. Viruses obtained from two humans, one horse, and mites from Louisiana and Tennessee were identified as Eastern Equine Encephalomyelitis by cross immunity tests in guinea pigs.

9. The virus of Eastern Equine Encephalomyelitis was recovered from mosquitoes, chicken mites, and chicken lice from Tennessee; mosquitoes and chicken mites from Louisiana; and from Texas mosquitoes by inoculation into mice. The mites and lice from Tennessee were *Dermanyssus gallinae* and *Menopon biseriatum*, respectively. The other arthropods were not identified as to species.

10. Thirty-four dog sera from Thomasville, Georgia were tested by aggluti-

nation tests against *Leptospira canicola* and *L. ictohemorrhagiae*. Percent positive to *L. canicola* in a dilution of 1-1,000: 41.1; 16.4% in 1-1,000 dilution and 8.8% in a 1-100,000 dilution. All were negative to the human strain of *Leptospira*.

11. Neutralization tests were carried out on sera from many parts of the nation. Fourteen of 145 human sera (9.6%) were positive against E.E.E. virus, 13 of 119 (10.9%) against W.E.E. virus and none of sera against St. Louis encephalitis virus.

12. A small scale mycological diagnostic service was rendered to several Federal and State agencies. A total of 305 cultures was examined and reported.

13. A total of 1,307 routine reference specimens for diagnosis of tuberculosis consisting of 914 sputa, 285 gastric washings, and 108 body fludis, was received from Lawson Veterans' Hospital No. 48, Georgia State Public Health Laboratories, and Battey General Hospital. These were examined microscopically, culturally and by animal inoculation.

BRANCH NOTES

BACTERIOLOGY BRANCH COMPLETES NEW LABORATORY

The Serology Laboratory was completed during the quarter. Personnel and equipment for performing rickettsial serology at the Montgomery station were transferred to Lawson on December 15, 1947. This work was resumed under the direction of Dr. James H. Schubert. Serological diagnosis of leptospira infections were carried out on a small scale.

MYCOLOGY SECTION CHANGES PLANS FOR LABORATORY. Plans for the establishment of Mycology Laboratories at Duke University were changed and S. A. Scientist Libero Ajello was transferred to Atlanta to set up and direct the mycology laboratories at Lawson. Dr. Norman Conant continues as a consultant to the Laboratory Division and will participate actively in the laboratory program on a part-time basis.

TUBERCULOSIS SECTION. Nine specimens from Alaska, Washington, D. C., and Atlanta, were examined for organism type identification.

The work of the Tuberculosis Evaluation Laboratories progressed favorably. Routine and research problems entailed the use of 327 guinea pigs, 300 mice and six rabbits. A future issue of the Bulletin will be devoted to the work of the Tuberculosis Section.

A comparative evaluation of microscopic diagnosis of tuberculosis carried out between the Georgia State Public Health Laboratories and the Lawson laboratories showed a 96.6% correlation of 537 specimens studied.

Engineering Division

PERSONNEL CHANGES

Sanitary Engineer Chris A. Hansen was transferred from his duties as Assistant Chief of the Engineering Division to the Executive Office. Engineer (R) Lawrence B. Hall was transferred from the Production Division to fill the resulting vacancy.

MALARIA CONTROL ACTIVITIES

Residual spraying operations continued in nine states after October 1. Only key personnel were retained on federal payrolls after the termination of the spraying program. These persons will carry on the necessary mapping and promotional activities during the off-season period and will recondition and repair equipment for 1948 seasonal operations. Only 352 Civil Service personnel were employed in malaria field activities on December 31. This is perhaps the lowest employment figure since the residual spraying program was inaugurated.

SUMMARY OF DDT RESIDUAL SPRAY OPERATIONS

October 1 — December 31, 1947

STATE	NO. COS.	NO. HOUSES SPRAYED	LBS. DDT	MAN-HOURS			LBS. DDT PER HOUSE	M.H. PER HOUSE	M.H. PER LB. DDT	CUMULATIVE JULY 1-DECEMBER 31, 1947	
				CDC	LOCAL	TOTAL				TOTAL HOUSE SPRAY APPLIC.	TOTAL LBS. DDT
Alabama	8	2,181	1,950	5,878	1,107	6,985	0.89	3.20	3.58	46,883	45,678
Arkansas	11	2,458	1,502	20,957	2,690	23,647	0.61	9.62	15.74	81,142	67,828
Florida	2	1,380	1,050	280	1,112	1,392	0.76	1.01	1.33	33,839	33,509
Georgia	1	9	7	–	24	24	0.78	2.67	3.43	89,722	71,331
Kentucky	0	—	—	2,672	1,159	2,831	—	—	—	4,697	5,299
Louisiana	0	—	—	1,280	—	1,280	—	—	—	7,540	7,364
Mississippi	0	—	—	5,120	—	5,120	—	—	—	53,993	27,503
Missouri	6	3,167	1,023	4,392	1,672	6,064	0.32	1.91	5.93	39,222	22,943
North Carolina	2A*	126	95	240	140	380	0.75	3.02	4.00	19,442	15,816
Oklahoma	9	766	758	304	1,156	1,460	0.99	1.91	1.93	15,802	16,469
South Carolina	26	6,841	6,299	11,737	9,049	20,786	0.92	3.04	3.30	100,598	87,003
Tennessee	0	—	—	3,381	560	3,941	—	—	—	3,727	5,479
Texas	17	4,057	3,348	6,718	4,601	11,319	0.83	2.79	3.38	46,780	49,677
TOTALS	82	20,985	16,032	62,959	23,270	86,229	0.76	4.11	5.38	543,387	455,899

*Areas

Note: Man-hours include time spent on off-season activities connected with the residual spray program.

Information on the method of obtaining local participation used in each state for the residual spray program was solicited. Analysis of this information emphasizes the fact that states collecting fees for local participation have unit house spray costs almost double those in states where participation is obtained by other methods.

TYPHUS CONTROL ACTIVITIES

Tabulations on a program-wide basis were received in November for ectoparasites and rat bloods for the first quarter of fiscal year 1948. These were summarized in tables and graphs, making available a total of two years' results on DDT dusting activities. The frequency of *X. cheopis*, rat typhus and human typhus were all lower in 1947 than in 1946, giving an over-all decrease in reported typhus not attributable to DDT dusting. Counties dusted, however, still showed an appreciable differential decrease over those not dusted, but not as much as in 1946. In dusted counties, a decrease in typhus of 41.8% over 1946 had occurred by the end of October.

Alabama, Georgia, and Louisiana elected to use five percent DDT dust during the coming season. Tennessee is planning to use five percent dust on half of its projects.

Between September 1, 1947 and November 22, 1947, 91,083 premises were treated with 10% DDT dust in the 11 states participating in typhus control activities. During the same period, a total of 56,212 premises in these states were poisoned for rats.

IMPOUNDED WATER STUDIES

Ten malaria survey reports were completed and submitted through channels to the Corps of Engineers during the quarter.

Tentative recommendations were submitted to the Missouri Department of Public Health and Welfare for location and operation of wild life areas on the Clearwater Reservoir. Also, recommendations were submitted for preparation and operation of proposed impoundments on the Osage River and its tributaries in Missouri and Kansas.

Muscogee County General Insect Control Project operations were terminated October 11, 1947 and the project was considered closed.

Entomology Division

RESIDUAL SPRAY PROGRAM, 1947

Results of 1947 spraying operations reveal that as long as five months after DDT spraying, only 1.2% of sprayed houses inspected contained mosquitoes while 28% of the unsprayed houses inspected showed the presence of mosquitoes. These results compared favorably with those obtained in 1946. Observations on comparative fly abundance about treated and untreated premises showed that, when the house-frequenting fly density indices outside houses were zero, flies were found inside only 23% of sprayed houses but were present in 34% of the unsprayed houses. When outside density indices stood at 1-10 flies, 41% of the sprayed houses had flies present, while 85% of the unsprayed houses contained flies. At outside density indices of over 10 miles, 55% of the sprayed houses contained flies as compared to 65% in the unsprayed houses.

RESULTS OF A SPECIAL DDT SPRAYING PROGRAM, MISSISSIPPI, 1947. During the 1946-47 season in Warren County, Mississippi, one DDT application per house was made in each of two areas at rates of 185 and 323 milligrams per square foot, respectively. In the area treated with 185 milligrams, only one house was found to be mosquito-positive after a total of 50 inspections while in an adjacent unsprayed area 20 houses out of 26 inspected were mosquito-positive. On this basis 97.7% fewer houses in sprayed areas were infested with mosquitoes.

From the results of this special project in keeping houses free of malaria mosquitoes, it was concluded that the heavier application rate was no more effective over the same length of time than was the lighter application rate.

ECTOPARASITE BRANCH

TYPHUS CONTROL EVALUATION. From January through September, only 11% of rats from dusted premises were infested with *X. cheopis;* 27% from undusted premises had *X. cheopis.*

There was a drop from 42% in 1946 to 27% in 1947 in the undusted rats infested with *X. cheopis.* No corresponding drop in infestation of rats from dusted premises occurred since during both 1946 and 1947, 11% of the rats from dusted premises had *X. cheopis.* Probably not over 15% of cheopism in rats occurred in dusted premises at its highest rate during September, now lower than 9% at its lowest rate about March.

Mites Show Decrease on Dusted Premises. Only 29% of rats from dusted premises bore mites, whereas 58% of rats from undusted premises were mite-infested. These data were essentially the same as in 1946, being 26% and 60% respectively. Figures for 1947 indicate some possible control of lice since only 35% of rats from dusted premises were infested as compared with 45% from undusted premises. Somewhat similar figures were obtained in 1946 when 33% of rats from dusted premises and 38% from undusted premises were louse infested. Data for both mites and lice probably are somewhat less accurate than for fleas and hence should not be compared within the same narrow limits.

In 1947 fewer rats were positive for typhus in both dusted and undusted areas than in 1946. For the nine months, ending with September, the percentages were 24% and 35% respectively for undusted premises and 22% and 31% respectively for dusted premises.

Difference Favoring Dusted Rats. Comparing figures of positive rats from dusted and undusted premises for the same year, a slight difference in favor of dusted rats is shown: 1946 — undusted, 35% were positive; dusted, 31% were positive; 1947 — undusted, 24% were positive; dusted, 22% were positive.

Effectiveness of Control. Other details investigated regarding effectiveness of control operations:

1. Relation Between the Percentage of Rats Infested and the Average Number of Fleas per Rat. It was found that when 100 or more rats were examined, a close positive correlation existed. When 10% of the rats were infested, the average number of fleas per rat was 0.5. When only 8% were infested, the average number per rat was 0.3 or less. This correlation is considered useful in rapidly evaluation results of control.

2. Duration of Control After Application of 10% DDT Dust. Optimum effectiveness occurred up to 120 days after dusting, although some control was noticeable for as long as 180 days.

3. Seasonal Incidence of *X. Cheopis*. The peak of seasonal abundance of fleas occurs during May in Florida and progressively later in more northerly latitudes. It has been recorded as occurring as late as October in Tennessee and North Carolina. Seasonal peaks of abundance of rat mites, except *nuttali* occurr earlier than for fleas.

4. Timing of DDT Dust Applications. Since mites are quite resistant to DDT, it is believed that applications may well be made early enough to include them. However, an application should not be made before 120 days preceding the peak of *X. cheopis* if only one is made.

PLAGUE INVESTIGATIONS. Plague was found in October in fleas from wood rats (*Neotoma*) caught in Dawson County, eight miles west of Lamesa, Texas. Approximately 650 native mammals and 8,000 fleas had been examined by that date. Of approximately 400 domestic rats examined, none were found plague-infested and only 7% bore *X. cheopis* fleas. The incidence of cheopism varied from nearly zero to as high as 15% at the height of the season. Sticktight fleas were found on 3-70% of the rats. Most rats were caught in small towns or on farms and ranches.

DYSENTERY CONTROL PROJECT

EVALUATION OF FLY CONTROL METHODS. Various types of ground insecticidal mist dispersing machines are being compared with one another and with hand equipment as to their effectiveness in DDT distribution for fly control. Good reductions in fly counts were obtained in all tests during the quarter, but poor fly breeding conditions made reliable evaluations of the different control methods impossible.

MALARIA FIELD INVESTIGATIONS

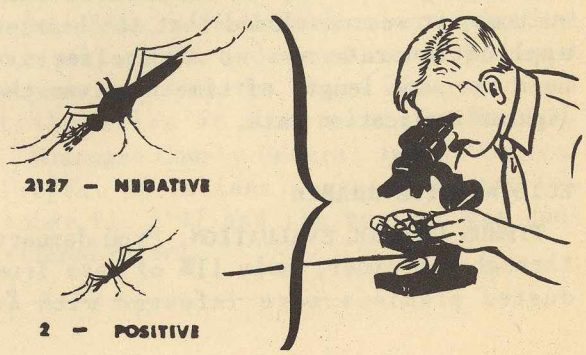
MANNING, S. C.

INCIDENCE. A comparatively low monthly incidence of malaria (0.0% — 0.5%) was obtained throughout 1947 in the two most malarious subsections of the study area. The seasonal positive rats obtained from the examination of blood slides (4,200) during 1947 from these subsections was 0.21%. In contrast, the rate in October 1944 was 38.2%.

MOSQUITO POPULATIONS. *Anopheles quadrimaculatus* densities reached a seasonal low early in October and no adults were collected after mid-November. *A. crucians* densities, however, increased somewhat during October but declined to zero in November.

MOSQUITO DISSECTIONS. Of 2,127 *A. quadrimaculatus* dissections only two positives were found, giving a rate of 0.09%. A total of 5,206 dissections was made on *A. crucians*. Eight positives were found, giving a rate of 0.16%.

HOST PREFERENCE STUDIES. A total of 3,837 *A. crucians* bloods was tested during the 1947 season. One was human; three were avian. Out of 344 *A. quadrimaculatus* bloods tested, no human or avian bloods were



found. Analyses of accumulated data on human parasitemia incidence, the infectivity rate of local malarias for anophelines, and the human blood feeding rate found for *A. crucians* are being made in an effort to determine whether the *A. crucians* sporozoites might be of human origin.

EMORY UNIVERSITY FIELD STATION, NEWTON, GEORGIA

EPIDEMIOLOGICAL OBSERVATIONS. No malaria was detected during regular nursing visits to residents of the experimental area.

HYDROLOGICAL WORK. Additional observation wells were established in two ponds to measure height of the water table beneath the ponds. Measurements of water levels in a deep well, extending into Ocala limestone, and an adjacent shallow well, were begun. Previous ground water observations have been made of the shallow water table so that information concerning relative levels and variations is not available.

Statistical work in connection with formulation of a pond-level reduction equation was advanced.

Technical Development Division

INSECTICIDE INVESTIGATIONS BRANCH

TWENTY-ONE CHEMICALS SHOW NO RESIDUAL TOXICITY. Twenty-eight compounds were subjected to rapid screening tests using adult flies. Twenty-one chemicals were dropped from further consideration because no residual toxicity was shown. Seven other chemicals showed some residual toxicity but only three were considered for further testing: "Lorol" thiocyanate, lauryl thiocyanate, and one other chemical whose identity cannot be revealed at the present time.

Fifteen insecticide solvent combinations used in standard panel tests with house flies were compared to deposits from a standard five percent DDT-xylene emulsion applied at the rate of 200 mg., or 4 ml. per square foot. DDT water wettable powders were applied as finished sprays containing five percent concentration of the active ingredient. Foaming and clumping caused considerable variation in the ease of preparing the finished sprays. Wettable powder containing 75 percent DDT maintained excellent residual toxicity over a 26 week period and proved better than DDT-emulsion deposits against house flies.

WATER-WETTABLE DDT SHOWS LONG RESIDUAL ACTIVITY. In like manner, eleven chemicals were used in standard panel tests against *A. quadrimaculatus* mosquitoes. As was the case with house flies, the 75 percent DDT water-wettable powders produced a long residual activity. The twenty-four hour mortality of adult female quads after a 60-minute exposure period to a 27-week-old 75-percent-DDT residue amounted to 90 percent.

Evaluation of DDT samples from field control programs was carried out by a modification of the rapid screening technique in which exposure periods were shortened to give more critical determinations. In general, samples submitted from the field compared favorably with the laboratory standard formulations.

Results with DDT in cold water paint indicated that although there was an appreciable kill of house flies from the DDT-paint mixture at a 30-minute exposure, the incorporation of DDT into the paint had occluded its activity to some extent at the shorter, more critical exposure period of 15 minutes.

Evaluation of oil-base paints with DDT was conducted over a four-week period. Four types of finish were tested: ivory, white, clear, and black. The residual effectiveness of the ivory and white paints proved very good, in spite of the fact that they

were difficult to apply evenly. In contract to oil-base paints previously tested, the effectiveness of the DDT was not occluded by paint oils and pigments. The clear finish, while having a good initial toxicity, did not hold up under repeated testing in the same spot. The black finish gave better results when the same areas were re-tested.

Two species of blow flies, *Callitroga macellaria* and *Phaenicia pallescens* are now being reared in quantity in the insectary.

CONTROL METHODS AND EVALUATION BRANCH

LARVICIDING PLAN TO PROTECT FISH LIFE STUDIED. Although all identification work in the study of effects of routine airplane applications of DDT on wildlife have not been completed, gross results indicate that two years of treatment with DDT at the output rate of 0.1 lb. per acre does not reduce fish populations.

In considering DDT applications alone, best results were obtained with two treatments at the rate of 200 mg. per square foot per treatment where the second treatment followed the first by approximately three months. Dosage rates of 300 and 400 mg. per square foot gave some increased effectiveness over 200 mg. applications. At the 800 mg. per square foot dosage, no further increase in effectiveness was shown as compared with 400 mg. deposits.

Data from tests of the comparative effectiveness of various water-wettable preparations of DDT indicated some masking action by inert ingredients. It is most desirable to use DDT water-wettable preparations that contain the highest concentration of technical DDT. In locations where unsightly residues resulting from application of water-wettable powders is of no consequence, tests indicate that a slight advantage might be obtained with a 75-percent-DDT water-wettable powder as compared to the regular xylene emulsion.

FLIES IN COMMERCIAL PLANTS. Applications of a xylene emulsion containing five percent DDT were made at the rate of 200 mg. DDT per square foot to interior walls and ceilings of a sausage manufacturing plant and a freezer-locker plant. Applications of a 2½-percent emulsion were also made to the exterior vegetation around these plants. Results indicated that house fly and blow fly populations were effectively reduced or tended to maintain a low level for periods ranging from two months to a full season.

Tests were conducted in 1947 to compare DDT and chlordane emulsions for control of blow flies around abattoirs. Two and one-half percent emulsions were used for each chemical. The extent of control was influenced greatly by regular removal, or lack of removal, of waste products. At locations where waste removal was infrequent, populations below pretreatment fly levels were maintained for 3 to 4 weeks; at locations where waste removal was frequent, good control of flies was maintained for periods up to 8 weeks. In general, the period of control was from 4 to 6 weeks with both DDT and chlordane.

HOOKWORM CONTROL INVESTIGATIONS. Among larvicides tried, the cyanamids have received the most thorough testing. $CaCN_2$ and Na_2CN_2 are about equally effective whether applied to soil immediately before or immediately after infestation.

The cyanamids, along with other candidate materials, were applied dry at the rate of 1,000 pounds per acre, applied as solutions at the rate of 1,000 pounds per acre ($CaCN_2$ excepted, due to its poor solubility in water), and as dry treatments of 2,000 pounds per acre. In general, differences between results of cyanamide dosage rates of 1,000 and 2,000 pounds per acre did not appear to be highly significant.

Tests with urea, ammonium chloride, and the cyanamides indicated that the formation of ammonia gas appeared to be correlated with the destruction of hookworm larvae. Chlorides may kill hookworm larvae by causing changes in osmotic pressure. Aluminum chloride, however, is thought to be toxic because of its acidity. Both naphthalene flakes and paradichlorobenzene gave

striking results when applied to the surface of hookworm cultures. Orthodichlorobenzene, when applied as 95 percent technical material at the rate of 120 gallons or more per acre, has been 100 percent effective in tests performed so far.

RODENT AND ECTOPARASITE CONTROL BRANCH

SOME FLEA INDICES REDUCED TO LESS THAN ONE PER RAT. Tests of the value of a five-precent-DDT xylene *Triton X-155* water emulsion for the control of rat ectoparasites (when applied at the average rate of 200 mg. of DDT per square foot) were initiated in Lowndes County, Georgia in March 1947. (See Jan.-Feb.-Mar. "CDC Bulletin" p. 19).

On untreated rural premises, an average of 2.1 *X. cheopis* fleas per rat was found. Eleven days after treatment this index was reduced to 0.03 and failed to increase above 0.1 over a period of four months. Effective *X. cheopis* control ceased sometime between four and six months following insecticide application. In contrast to *X. cheopis* spraying, *L. segnis* DDT spraying was performed when the population was high. Following spraying, this population was reduced from an average of 9.6 fleas per rat to 0.3. In addition to *X. cheopis* and *L. segnis*, a relatively few *Echidnophaga gallinacea*, the sticktight flea, and *Rhopalopsyllus gwyni* were taken. General flea indices were maintained at a satisfactory low level of from 0.3 to 1.0 per rat for a minimum period of four months.

Results of DDT residual spraying on rat ectoparasites other than fleas indicated that five-percent-DDT emulsions had considerable effect upon the abundance of the tropical rat mite, *Liponyssus bacoti*, but not upon the rat louse, *Polyplax spinulosa*.

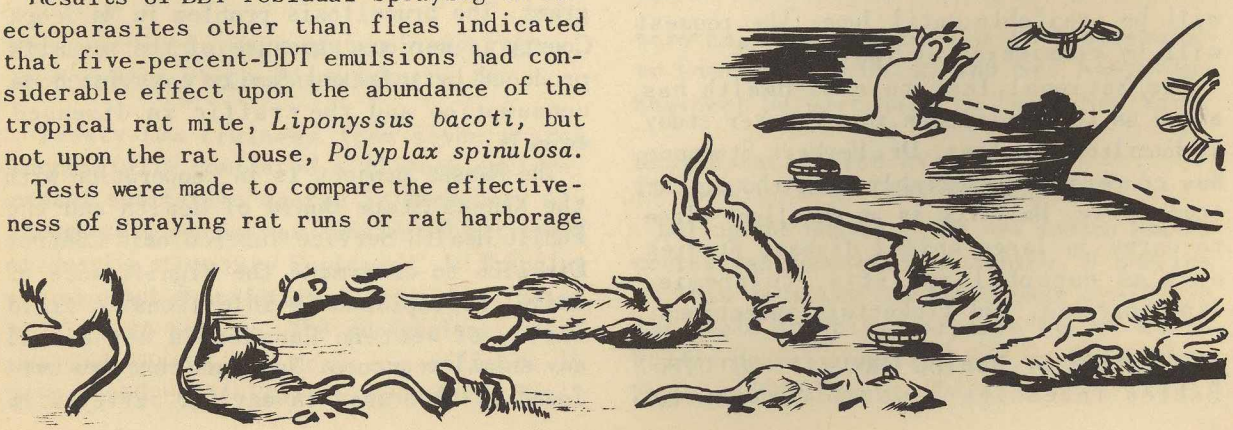
Tests were made to compare the effectiveness of spraying rat runs or rat harborage for the control of *X. cheopis*. Treatment of harborage with a five-percent emulsion of DDT produced the most satisfactory control; *X. cheopis* populations were nearly eliminated. Treatment of rat runs produced variable results.

RODENTICIDE STUDIES. Tests were conducted to determine the minimum concentration of "1080" that can be used against *Rattus norvegicus* to produce consistently good results with least danger to other animals and to man. Tests were made on adult rats with concentration of 1, 2, 4, 6, 8, 10, 12, 14, and 16 grams of "1080" per gallon of water. Each dosage was tested on a minimum of 54 rats. An average mortality of 90 percent was achieved with the 12-gram concentration. A dosage of 14 grams per gallon gave as good or slightly better results than did 12 grams per gallon, but the possible superiority of the former does not out-weigh the higher degree of safety attained by using a lower concentration. Dosages below 12 grams per gallon did not give consistently good kills. At 16 grams per gallon and above, there was a reduced amount of tasting and consequently fewer kills.

VECTOR TRANSMISSION BRANCH

Biological studies of *Liponyssus bacoti* were concerned with total egg production of single females and with sex determination of offspring of unfertilized females.

Results so far indicate that parthenogenesis occurs regularly if the female is not fertilized and that parthenogenic eggs hatch readily.



Veterinary Division

BRANCH NOTES

INVESTIGATIONS BRANCH

PSITTACINE BIRD REGISTRY RECOMMENDED. Investigations of psittacosis were inaugurated in states where veterinary public health personnel is assigned. Findings to date indicate that the Public Health Service Inter-State Quarantine Regulations are bitterly resented by commercial aviaries of the South and West. Bird fanciers resent the action because it stops bird trading. In states that formerly imported psittacine birds, local aviaries are beginning to raise their own psittacine fowl. Some northern states welcome the interstate ban, because it protects them from low cost production areas. It is apparent that 48 separate psittacine bird problems are replacing the former regional and national problem. This division has recommended that all states set up a psittacine bird registry and institute some sanitary supervision.

VETERINARIAN REQUESTED FOR CALIFORNIA. Q fever is causing considerable concern in southern California. About 150 human cases have been reported. Cattle show an infection rate of 30% on one raw milk dairy farm. The National Institute of Health investigators have asked the State Veterinarian to take over the animal and milk investigations, and State Veterinarian Carr has asked the Veterinary Public Health Division to assign a competent public health veterinarian to direct their study. No one will be available until June. The request will be considered at that time.

The National Institute of Health has asked us to participate in a Q fever study at Hamilton, Montana. Dr. Herbert Stoenner has cooperated in establishing the bovine study there. Hamilton is an excellent place to carry on large animal disease studies such as encephalomyelitis, tularemia, leptospirosis, and rickettsia infections.

DURATION OF RABIES IMMUNITY STUDIED. Rabies investigations at Montgomery, Alabama, are being expanded to study the duration of immunity. More than 200 dogs will be used in this study. Forty-four dog cages were obtained from the city authorities in Montgomery. Bids will be let during the next quarter for 56 additional cages.

Preliminary studies on the immunizing value and safety of chick embryo rabies vaccines were completed. The purpose of the experiment was to determine the safety and antigenicity of two new experimental vaccines developed by Doctors Cox and Koprowski of the Section on Viral and Rickettsial Research, Lederle Laboratories, Pearl River, New York. Preliminary studies in small numbers of dogs indicated potentialities in the use of chick embryo rabies virus as a safe and antigenic vaccine. Vaccine immunity tests and serum virus neutralization tests were also conducted.

CONTROL DEMONSTRATION BRANCH

NEW PROJECTS IN ARIZONA AND KANSAS. New projects were established in Arizona and Kansas. The Arizona demonstration will include rabies eradication, investigations of beef tapeworm, brucellosis, coccidioidomycosis, and Q fever. Rabies is prevalent in southern Arizona and has spread to wild animals. The U. S. Fish and Wildlife Service and the State Conservation Department are combating the wildlife rabies. Yuma, Tucson and Phoenix all are carrying on extensive immunization programs. The brucellosis problem in Maricopa County is serious, because of the raw milk produced by infected family cows for home consumption and the traffic in diseased animals.

The Kansas project is in cooperation with the Kansas State Board of Health and the Public Health Service Tuberculosis Control Division to determine the significance of animal histoplasmosis infections. A field survey of western Kansas did not reveal any animal reactors. No human reactors were found in that area in earlier surveys. In

eastern Kansas, animal reactors were found—some with active infection—in the same general area where human reactors are found.

BRUCELLOSIS AND RABIES STUDIED. The Colorado general demonstration completed its first full quarter. Rabies control, meat and poultry inspection programs, psittacosis, brucellosis, and Q fever have been the fields of activity. The arrangement was the same as that in other states. The Public Health Veterinarian was assigned to the state which paid all his expenses and supplied clerical aid and transportation. The state also agreed to find a permanent man for the position, who will be trained at state expense. The USPHS demonstration should terminate at the end of two years.

Utah studies of brucellosis continued in the field and laboratory. A series of almost 20,000 human blood samples have now been tested. New techniques and media for the isolation of brucella organisms from the udder are being developed. All strains isolated have been *B. abortus* (44 positive quarters from 156 quarters studied). The state continues to be free of rabies. Other activities have been in meat and poultry inspection programs. Utah has asked for a deficiency appropriation to employ their own public health veterinarian and send him to school this Fall.

The Indiana brucella survey has been awaiting the assignment of veterinarians and the B.A.I. mobile laboratory. They are expected early in 1948 upon the completion of foot and mouth disease work in Mexico. Rabies control, investigations of sporadic brucellosis outbreaks, and studies of other diseases of animal origin have been carried on. The comparative laboratory study of brucellosis diagnosis continues at the Indiana State Board of Health and Purdue University.

SPECIAL REPORT READY ON SALMONELLA AND BRUCELLOSIS. Salmonella studies in Michigan have expanded with the addition of two bacteriologists. Dog studies are being carried on at the State Health Department. To date, 80% of dogs challenged have developed evidence of disease. About 20% have remained infected after acute symptoms receded. Rabies activities continue to be an important part of the Michigan demonstration, as do other epidemiological services in the field of brucellosis, psittacosis, and enteric diseases. A special report on salmonella and brucellosis has been compiled and is available on request.

Training Division

SUCCESSFUL TRAINING COURSE COMPLETED AT COLUMBUS FIELD TRAINING STATION

Twenty-two trainees from seven states successfully completed a 12-week environmental sanitation course in December. Although this course was considered extremely productive, Sanitary Engineer C. D. Spangler recommended that future classes be limited to 15 or 16 persons. The professional staff was reduced to two training officers in January by the following transfers: Sanitary Engineer (R) Donald J. Schliessman to Cincinnati, Ohio; and Sr. Assistant Engineer Herbert Haas to Troy, New York.

HEALTH FACILITIES AVAILABLE TO ALBANY FIELD TRAINING STATION

During the quarter, the new modern health center was completed in Albany. A portion of this facility has been made available for field training purposes by Dr. David Wolfe, Health Commissioner, and Sanitary Engineer R. S. Howard, Jr.

SAVANNAH FIELD TRAINING STATION HAS ACTING SENIOR TRAINING OFFICER

Dr. Ruth Sumner has been acting as Senior Training Officer under the director, Dr. Clair A. Henderson. During the quarter, Dr. Sumner was responsible for conducting field training in public health education in this area. She also extended consulting service to training stations at Columbus, Ga., Topeka, Kansas, and Troy, New York. Groups of health educators from Arkansas and Georgia received training in health education and community organization. One trainee completed the course in record analyst training under Training Officer Charles C. Wilson. During the quarter, Mr. Wilson prepared training manuals and three supplements dealing with records in health departments. These were forwarded to Washington for comment.

NEW YORK STATE — RENSELLAER COUNTY TRAINING CENTER

Details of the three-month field training course for sanitary inspectors were worked out during the quarter. Ten trainees made up the quota for the first class which began January 5, 1948. The first class was limited to New York State trainees only but provision was made to admit trainees from other District No. 1 states during the May and September 1948 courses.

The Training Division has contributed training officers, clerical assistance, office equipment and supplies, training materials, and automobiles for trainees' transportation. The New York State Health Department has made available, and is maintaining, excellent training quarters and has furnished well equipped laboratory facilities sufficient to accommodate 15 trainees. Personnel of USPHS District No. 1 are cooperating in planning and conducting the work of this Training Center.

PROPOSED FIELD TRAINING AT CHAPEL HILL, N. C.

Dean Edward McGavran, School of Public Health, University of North Carolina, submitted a proposal for the development of a comprehensive field training program at the University of North Carolina before a public health conference held at Chapel Hill last October. Total annual cost of this proposed program: $108,000. Medical Director Raymond A. Vonderlehr and Senior Sanitary Engineer Ellis S. Tisdale were present at this conference.

Because of limited Training Division funds, the only promise of CDC aid that could be made was for the assignment of a sanitary engineer and a limited amount of equipment, total annual cost not to exceed $10,000.

STREAM SANITATION COURSE, CINCINNATI, OHIO

At the Water and Sanitation Investigations Station, a three-weeks training course designed to prepare graduate sanitary engineers to direct stream pollution was developed. The number of trainees attending this course (first begun March 15, 1948) was limited to 15.

MILK AND FOOD PROGRAMS AT FIELD TRAINING CENTER, TOPEKA, KANSAS

Special field training programs in milk and food sanitation were organized for 1948. Also, plans for the training of clerks were made.

HEADQUARTERS ACTIVITIES

INSECT AND RODENT CONTROL BRANCH. A training course on Rat-Borne Disease Prevention and Control was presented in Atlanta from October 13 through November 7, 1947. Fourteen men from 11 states and two foreign countries attended this course. In addition to health department personnel, representatives of the Fish and Wildlife Service, the Food and Drug Administration, and the pest control industry attended this four-week course.

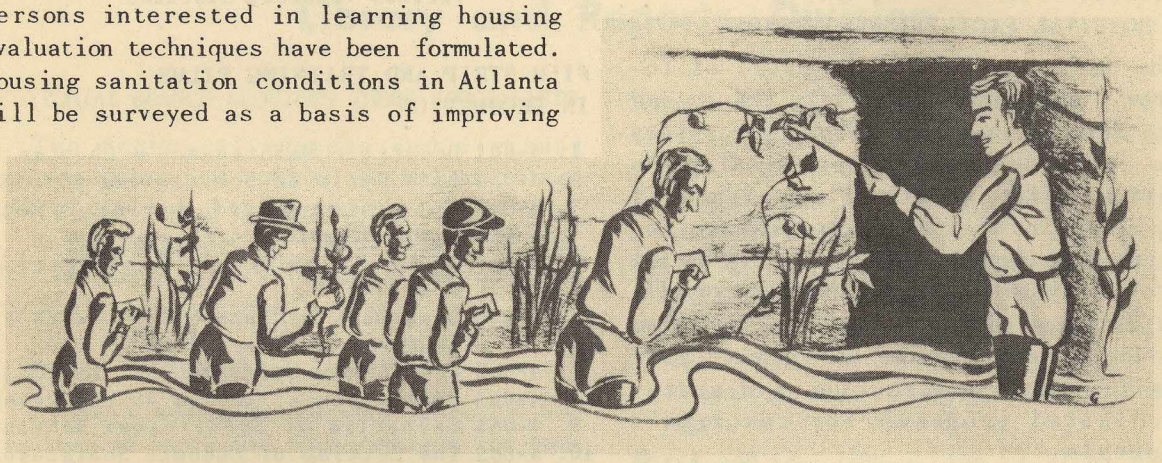
Scientist Ralph C. Barnes assisted Mr. J. E. Borches of District No. 2 in presenting two short insect and rodent control courses for personnel of the West Virginia State Health Department. These courses which were given at Clarksburg October 15 — 17 and at Beckley October 20 — 22 were attended by 50 sanitarians and

sanitary engineers.

Scientist Ralph C. Barnes and S.A. Engineer (R) Clyde F. Fehn presented field training in insect and rodent control at New Orleans, Louisiana November 17 — 20 as a part of the Louisiana Public Health Training Center's ten-week course for sanitarians. Cooperating agencies in this field training were the Louisiana State Health Department and District No. 4.

NEW HOUSING TRAINING PROGRAM. Plans for using the Atlanta area for training of persons interested in learning housing evaluation techniques have been formulated. Housing sanitation conditions in Atlanta will be surveyed as a basis of improving housing conditions. The Training Division estimates that about $10,000 will be spent during the first year on personnel, equipment, and supplies.

REORGANIZATION OF TRAINING DIVISION FILM LIBRARY. The main CDC Film Library was transferred from the Training Division to the Production Division in October. A sub-film library was organized as a section under the Administrative Branch of the Training Division.



Production Division

The Production Division completed its physical transfer of personnel and equipment to Lawson Hospital in December. The final phase of this transfer involved only the Photographic Laboratory and two of its personnel.

UTILIZATION BRANCH

The film library was transferred physically from the Training Division to the Production Division on October 1. Distribution was immediately put into effect. It is progressing as rapidly as expansion and development of the organization permit. Distribution for the Second Quarter FY 1948 totaled 340 shipments.

PREVENTIVE MEDICINE — PRODUCTION PLANNING CONFERENCE

A production planning conference was held on November 30 by the Production Division staff in cooperation with the Audio-Visual Committee of the Association of Professors of Preventive Medicine. Improved utilization of health and medical film was emphasized during this meeting. Many films were previewed to determine their usefulness in teaching preventive medicine.

CONFERENCE ON AUDIO-VISUAL AIDS PRODUCTION

Hygiene and public health professors attended an audio-visual conference with the staff of the Production Division at Lawson on December 5 to determine how schools of hygiene and public health can fit into the production program and how CDC may best meet their needs.

PRODUCTION FOR V. D.

Photographing venereal disease cases at

the USPHS Medical Center, Hot Springs, Arkansas, has been in progress and is continuing. Also, pictures from several other sources are being combined in a central file at the Venereal Disease Division, USPHS, Washington, D. C. This picture material, chiefly "stills" at present, supplemented by motion picture footage, will be issued in 2" x 2" slide sets, 35 mm film strips, and 16 mm motion picture units.

PRODUCTION FOR THE HOSPITAL FACILITIES DIVISION

The film strip "The Hospital of Tomorrow," was completed. Fifty prints and fifty sets of supplementary color slides were forwarded to Washington, D. C. An additional fifty prints of this film will be placed in the CDC film library for distribution upon request. Executive Secretary A.G. Stoughton of the Hospital Facilities Division plans to have this division produce a second film strip with more detail about construction and state-coordinated programs for tomorrow's hospitals.

THE INTER-DEPARTMENTAL PRODUCTION COMMITTEE

The Chief of the Division attended meetings of the Inter-Departmental Committee on Medical Training Films during the quarter. Current production of films was cleared and suggestions were received concerning alterations in content and method of treatment. A uniform production outline form was adopted for use by all agencies represented on the committee. Considerable time was spent in formulating final plans for the Medical Film Institute.

PRODUCTIONS COMPLETED AND RELEASED DURING THE QUARTER

1. 4-045 Aircraft Quarantine
2. 4-051 Spleen Puncture in Leishmaniasis
3. 4-058 Microfiliariae of *Wuchereria bancrofti*
4. 4-059 Infective Larvae of *Wuchereria bancrofti*
5. 4-060 Miracidia of *Schistosoma japonica*
6. 4-061 Movements of *Endamoeba histolytica*
7. 4-066 Snails (*Australorbis glabratus*)
8. 4-067 Miracidia and Eggs of *Schistosoma mansoni*
9. 5-076 Mosquito Inspection and Control
10. 5-081 Sanitary Designs in Drinking Fountains
11. 5-093 Fight Against Rabies
12. 5-100 The Hospital of Tomorrow

NOTE: Active work continued at the V. D. Center at Hot Springs, Ark., on production of colored slides and motion pictures on the lesions of various venereal diseases.

FILM STRIP AND TRAINING FILMS IN PRODUCTION

1. 4-001 Reservoir Maintenance — Chapter V
2. 4-034 Life Cycle of *Schistosoma mansoni*
3. 4-049 Epidemiology of Murine Typhus
4. 4-050 Typhus Complement Fixation
5. 4-053 Life Spirals of *Trichinella spiralis*
6. 4-056 Diagnosis of Tuberculosis with an Improved Culture Medium
7. 4-062 *Schistosoma mansoni*
8. 4-063 Schistosomes, Adults in the Veins
9. 4-064 Cercariae of *Schistosoma mansoni*
10. 4-065 The Setting of Endemic Schistosomiasis in Puerto Rico
11. 4-068 Pathology of *Schistosoma mansoni*
12. 5-015 Identification of U. S. Genera of Adult Female Mosquitoes
13. 5-030 Life Cycle of Malaria Parasite
14. 5-040 Clinical Falciparum Malaria
15. 5-043 Clinical Vivax Malaria
16. 5-052 Identification of Anopheline Larvae
17. 5-061 Identification of Anopheline Larvae
18. 5-073 Hookworm Disease and Hookworm Infection
19. 5-079 Fundamentals of Detergents
20. 5-082 The Rural Water Supply
21. 5-085 Closing In
22. 5-090 Spread and Prevention of Trichinosis
23. 5-092 Aquatic Plants Associated with *Anopheles* Mosquito Breeding Areas
24. 5-095 Worms in Your Muscles
25. 5-097 The Identification of Some Common Rat Lice
26. 5-105 Laboratory Diagnosis of Rabies
27. 5-109 Federal Public Health Organization 1948
28. 4-072 Life Cycle of the Hookworm
29. 4-073 Shellfish Sanitation
30. 5-106 The Liver
31. 5-115 Key to the Helminth Ova
32. 9-016 Dug Wells

33. 9-017 Drilled Wells
34. 9-018 Bored Wells
35. Panel Exhibit:
    Panel exhibit on rabies being made up for Southern APHA, New Orleans, for display first week in April 1948; also for APHA exhibit in Salt Lake City in May and APHA exhibit San Francisco in July.
36. Display for T. B. Division:
    "Laboratory Aids to Diagnosis," an exhibit to be presented at the American Trudeau Society meeting to be held in June 1948, consisting of a series of color transparencies of different types of culture media with the appearance of tubercle bacilli on the different media.

Library and Reports Division

EDITORIAL BRANCH ACQUIRES THREE SPECIALISTS

Two technical editors and a visual presentation-information specialist joined the staff during the quarter.

Work continued on issues of the "CDC Bulletin," annual report, orientation manual, and fly control manual.

LIBRARY INCREASINGLY USED

Library holdings include about 3,000 volumes of books and approximately the same number of volumes of periodicals. Acquisitions included 315 additional books.

In addition to CDC personnel, users of the library include local physicians and students. This increasing use by persons outside of CDC indicates the library is achieving one of its objectives in supplementing other facilities in the area. Selected acquisitions in the library:

LIST I

American Association for the Advancement of Science, "Approaches to Tumor Chemotherapy." 1947.

Anderson, C. G., "An Introduction to Bacteriological Chemistry." 1946.

Babbitt, H. E., "Sewerage and Sewage Treatment." 1947.

Bankoff, G. A., "The Conquest of Tuberculosis." 1946.

Boyd, William, "A Text Book of Pathology." 1947.

Boyd, W. C., "Fundamentals of Immunology." 1947.

Brues, C. T., "Insect Dietary." 1946.

Cahalane, V. H., "Mammals of North America." 1947.

Ditmars, R. L., "A Field Book of North American Snakes." 1946.

Goldberg, Morris, "English-Spanish Chemical and Medical Dictionary." 1947.

King, E. J., "Micro-Analysis in Medical Biochemistry." 1947.

Le Compte du Nouy, Pierre, "Human Destiny." 1947.

Merck and Co., Inc., "The Clinical Use of Streptomycin." 1947.

Merck and Co., Inc., "Streptomycin, Annotated Bibliography." 1947.

Mettler, C. C., "History of Medicine." 1947.

Miller, W. S., "The Lung." 1947.

National Organization for Public Health Nursing. Committee on Part-time Nursing Service to Industry. "Part-time Nursing in Industry." 1947.

Pregl, Fritz, "Quantitative Organic Microanalysis." 1946.

Rasmussen, A. T., "Some Trend in Neuroanatomy." 1947.

Sarett, L. R., "Basic Principles of Speech." 1946.

Smith, C. L. "Guide to the Laws Affecting Insecticides, Fungicides and Related Products." 1946.

Taylor, H. S., "Molecular Films — the Cyclotron and the New Biology." 1946.

Top, F. H., "Communicable Diseases," 2nd Edition, 1947.

U. S. Civil Service Commission, Medical Division, "A Guide for the Placement of

the Physically Impaired." 1947.

U. S. Navy, Naval Personnel Bureau, "Photography,v.1." 1947.

Waterbury, L. A., "Handbook of Engineering." 1947.

Weld, W. E., "How to Chart Facts from Figures with Graphs." 1947.

Wiener, Kurt, "Skin Manifestations of Internal Disorders." 1947.

Wolf, L. K., "Nursing."

Wolfenbarger, D. O., "American Midland Naturalist, v. 35, no. 1." 1946.

Zilber, L. A., "Far Eastern Tick-borne Spring-Summer (Spring) Encephalitis." 1946.

LIST II

Buxton, P. A., "The Louse." 1946.

Ceylon, Department of Medical and Sanitary Services. Committee on Malaria, "Malaria Control in Ceylon." 1945.

Dunbar, H. F., "Mind and Body; Psychosomatic Medicine." 1947.

Gray, Henry, "Gray's Anatomy." 29th Edition.

Kraines, S. H., "Managing Your Mind." 1947.

Leeuwenhoek, Anthony van, "Anthony van Leeuwenhoek and His 'Little Animals'!"" 1932.

Manter, H. W., "Laboratory Manual in Animal Parasitology." 1947.

Mather, Kenneth, "Statistical Analysis in Biology." 1947.

Rice, T. B., "A Textbook of Bacteriology." 4th Edition, 1947.

Rosebury, Theodor, "Experimental Air-Borne Infection," 1947.

Slaughter, F. G., "Medicine for Moderns." 1947.

Thorp, R. W., "Black-Widow — America's Most Poisonous Spider." 1945.

Weaver, Warren (editor), "The Scientists Speak." 1947.

Whitlock, J. H., "Illustrated Laboratory Outline of Veterinary Entomology and Helminthology." 1947.

"Who's Who" (British). 1947.

LIST III

American Public Health Association, "Standard Methods for the Examination of Water and Sewage." 1946.

Bustanoby, J. H., "Principles of Color." 1947.

Christie, A. B., "Infectious Diseases." 1946.

Conybeare, J. J., "Textbook of Medicine." 1946.

Cooper, H. J., "Scientific Instructments." 1946.

Crawford, C. W., "Introductory Problems in Engineering." 1947.

Davis, R. L., "Applied Plastic Product Design." 1946.

Duncan, G. G., "Diseases of Metabolism." 1947.

Duran-Reynals, Mary Louise, "The Fever-bark Tree." 1946.

Epstein, Samuel, "Miracles from Microbes." 1946.

Freeman, A. W., "Five Million Patients." 1946.

Gillett, L. H., "Nutrition in Public Health." 1946.

Green, E. R., et al (Editors), "Birds of Georgia." 1945.

Harrow, Benjamin, "A Textbook of Biochemistry." 1946.

Howell, W. H., "Textbook of Physiology." 1947.

Hubbard, C. Andersen, "Fleas of Western North America." 1947.

Hull, Thomas Gordon, "Diseases Transmitted from Animals to Man." 1947.

Jones, W. Paul, "Writing Scientific Papers and Reports." 1946.

Kamen, Martin D., "Radio-active Tracers in Biology." 1947.

Ledoux, Edward, "Vapor Absorption." 1945.

Manson-Bahr, Sir P. H., "Manson's Tropical Diseases." 1945.

McGarrett, Vincent, "Toward Better Photography." 1947.

Mees, C. E. K., "Path of Science." 1946.

New York Academy of Medicine, "Medicine." 1947.

Nicholls, Lucius, "Aids to Tropical Hygiene." 1946.

Olson, Lyla Mae, "Improvised Equipment

in Home Care of the Sick." 1947.
Pinner, Max, "Pulmonary Tuberculosis." 1945.
Polyak, Stephen Lucian, "The Human in Anatomical Transparencies." 1946.
Porter, J.R., "Bacterial Chemistry and Physiology." 1946.
Rahn, Otto, "Injury and Death of Bacteria by Chemical Agents." 1945.
Ridgway, Robert, "The Birds of North and Middle America." Pt. 10 Smithsonian Institute Bulletin No. 50 1946.
Sinnott, E.W., "Botany; Principles and Problems." 1946.
Smith, H.M., "Handbook of Lizards." 1946.
Spiegel, A.S., "X-Ray Diffraction." 1947.
Sterling, Alexander, "Clinical Allergy." 1947.
Stiles, K.A., "Handbook of Microscopic and Characteristics of Tissues and Organs." 3rd. ed. 1946.
Stimson, P.M., "A Manual of the Common Contagious Diseases." 4th. ed. 1947.
Taylor, Norman, "Cinchona in Java." 1945.
Turrell, F.M., "Tables of Surfaces and Volumes of Spheres." 1946.
U. S. Representation to the Atomic Energy Commission, "The International Control of Atomic Energy, Scientific Information Transmitted to the United Nations Atomic Energy Comission, June 14, 1946 — October 14, 1946." 1946.
U. S. War Department, "Methods for Laboratory Technicians." 1947.
Wadsworth, Augustus Baldwin, "Standard Methods of the Division of Laboratory and Research of the New York State Department of Health." 1947.
Wain, Harry, "The Unconquered Plague." 1947.
Waterman, T.L., "Nursing for Community Health." 1947.
Wilson, D.W., "A Laboratory Manual of Physiological Chemistry." 1947.
Wintrobe, M.M., "Clinical Hematology." 1946.
Wiselogle, F.Y., "A Survey of Antimalarial Drugs." 1946.
Zimmerman, Oswald Theodore, "DDT, Killer of Killers." 1946.

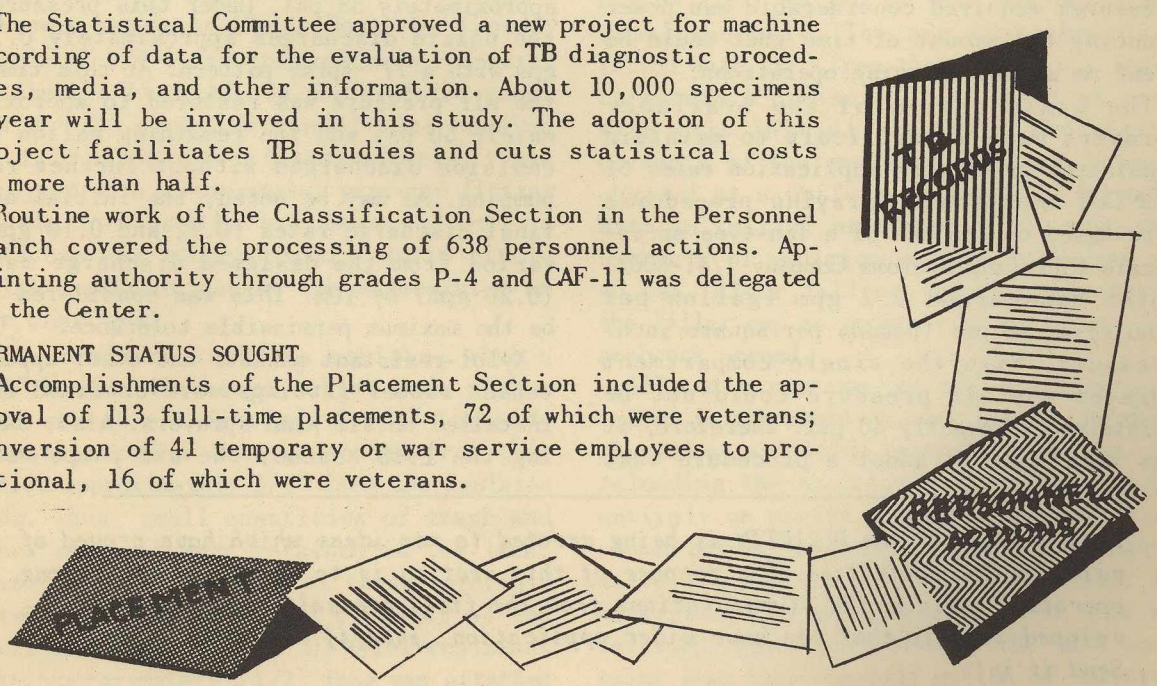
Administrative Division

The Statistical Committee approved a new project for machine recording of data for the evaluation of TB diagnostic procedures, media, and other information. About 10,000 specimens a year will be involved in this study. The adoption of this project facilitates TB studies and cuts statistical costs by more than half.

Routine work of the Classification Section in the Personnel Branch covered the processing of 638 personnel actions. Appointing authority through grades P-4 and CAF-11 was delegated to the Center.

PERMANENT STATUS SOUGHT

Accomplishments of the Placement Section included the approval of 113 full-time placements, 72 of which were veterans; conversion of 41 temporary or war service employees to probational, 16 of which were veterans.



IDEA EXCHANGE

A REGULATED PRESSURE SPRAYER FOR MALARIA CONTROL OPERATIONS

by

Louva G. Lenert
Georgia State CDC Director

and

William A. Legwen
Georgia Assistant State CDC Director

Commercial type hand sprayers were used in 1945 when Georgia DDT residual spraying operations were begun. Sprayers of this type were not designed for continuous use with xylol base emulsions. As a result, frequent delays were encountered due to failure of the pumping mechanism, the ring type gaskets or soldered joints in the sprayer tank. Also, the frequent pumping necessary to maintain satisfactory air pressures required considerable man power reducing the amount of time that could be spent on actual spraying operations.

The basic design of the available sprayers made it difficult to maintain consistent or uniform application rates of the DDT emulsions. Spraying procedures were based on the use of a fan-type spray-nozzle (Spraying Systems Company 1/4T-8002) which discharged 0.2 gpm (gallon per minute) at 40 psi (pounds per square inch) pressure. With the single compartment sprayer the air pressure could not be maintained at exactly 40 psi. Therefore, it was necessary to adopt a procedure that would result in an average discharge of 0.2 gpm. The procedure was to load a four-gallon sprayer with two gallons of emulsion and then pump the sprayer until a pressure of approximately 50 psi was obtained. Under this pressure, the nozzle discharges approximately 0.22 gpm with an 82° spray pattern. After one gallon of emulsion was discharged, requiring approximately five minutes, the air pressure was reduced to approximately 33 psi. Under this pressure, the nozzle discharges approximately 0.18 gpm with a 77° spray pattern. At this time, the air pressure was restored to approximately 50 psi and the remaining gallon of emulsion discharged without further re-pumping. As may be noted, the initial and final discharge rates (0.22 and 0.18 gpm) varied from the designed discharge rate (0.20 gpm) by 10%. This was considered to be the maximum permissible tolerance.

Xylol-resistant gaskets and other appurtenant rubber fittings were obtained and installed on all hand sprayers. Also, during the 1945 season, the air pumps were

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This section of the BULLETIN is being devoted to new ideas which have proved of value in CDC activities. The purpose of this section is to exchange ideas among operating units of CDC. Contributions from the field are solicited. Any idea developed locally that can have wider application, even if not new, is welcome. Send it in!

removed and the hand sprayers were equipped with air filling valves. Each spray truck was equipped with a reserve air tank (40 to 80 gals. capacity, filled from commercial or privately owned compressors) in order to intermittently supply the hand sprayers with air through the air filling valves. The reserve air tanks were equipped with tire inflators (Tru-Flate No. 711) with which the air pressure in the hand sprayer could be measured and also increased to the desired pressure. While these changes in equipment improved the production rate about 30% to 40%, by eliminating the manual pumping operations and reducing maintenance delays, the objections of varying air pressures and consequent varying discharge rates were not overcome.

In July 1946, a sprayer was designed which eliminated the objectionable features of the modified commercial sprayers. It was designated as the "Regulated Pressure" (RP) sprayer. It was composed of two 500 cubic inch (approximately 2 1/6 gals. capacity – 5" diameter x 23 1/4" long) tanks (surplus U. S. Army Air Force type, designed for working pressures of 400 psi). One was used for air storage and the other for emulsion. An air filling valve was incorporated in the air tank which, through a pressure regulator (Watts Regulator Company No. 26 AC 1/4") and stopcock, was connected to the 1 1/2" nipple in the emulsion tank. The 1 1/2" emulsion tank filler opening (1 1/2" nipple — silver soldered) was equipped with a commercial pipe-cap fitting to which a handle had been welded. In this cap was incorporated a solid circle Xylol-resistant gasket for maintaining an air tight seal.

The emulsion tank was equipped with a 1/4" bottom discharge outlet made with a 1/4" street ell fitting. A 1/4" (outside diameter) copper tube protruded from this outlet approximately 3/4" into the emulsion tank. Thus, small quantities of trash and other sediment were retained in the tank. This prevented entrance of these materials into the outlet hose and clogging of the nozzle strainer. A 1/4" ID Xylol-resistant hose, approximately 5 1/2' long was attached to the discharge outlet by means of a 1/4" hose bib. To the hose were attached a shut-off valve (Hudson), 1/8" pipe wand (18" to 30" length) and nozzle (Spraying Systems Company 1/4T-8002).

The air and emulsion tanks were banded together (with 1/2" rubber separators) and incorporated into the carrying frame composed of a 2"x6"x8" wood block and 5/16" black iron rod. The assembled sprayer was manually transported by means of a web sling, permanently or temporarily attached to the carrying frame.

Figure 1 illustrates the carrying position of the sprayer; Figure 2 illustrates the air and emulsion loading of the sprayer from a typical crew truck; and in Figure 3, an exploded view of a sprayer, with key letters, is shown. The keyed component parts of the sprayer are shown in Table 1. Figure 4 illustrates accessory equipment (described in Table 2).

Before issuance to Georgia field crew personnel, the pressure regulators were set to maintain an air pressure of 40 psi in the emulsion tank.

In operating the RP (Regulated Pressure) sprayer, after closing the stopcock (W) and removing the filler cap (G), either tank may be first filled or both may be filled simultaneously. The air tank should be filled with air (from the reserve air tank) to obtain a pressure of at least 85 psi. With this initial pressure, the entire contents of the emulsion tank may be discharged at a uniform pressure of 40 psi. With an initial pressure of 125 psi, two tankfuls of emulsion may be discharged at 40 psi. After filling the emulsion tank, the filler cap is securely attached and the stopcock opened.

All, or a portion, of the emulsion contained in the emulsion tank now may be discharged at a uniform pressure of 40 psi. In reloading the emulsion tank, which may be entirely or partly empty, the stopcock is closed before the emulsion tank air-pressure is released by removing the filler cap. In Georgia operations, the emulsion tank is refilled when empty, or when the tank contains less than one-half gallon of emulsion

after an individual spraying is completed. Air tank pressure is restored to at least 85 psi whenever emulsion is added.

In spraying operations, the usual carrying position is as shown in Figure 1 with the sling over the left shoulder, the RP sprayer on the operator's back, with the shut-off valve held in the right hand. Some operators utilize two slings with one over each shoulder and others carry the RP sprayer under one arm, partially supported with one hand.

It should be noted that considerably less air volumes are required in operations utilizing the RP sprayer than in those utilizing single compartment sprayers. To discharge one gallon of emulsion from the RP sprayer, only one gallon of air at 40 psi is required while with other sprayers, a minimum average air volume of 1.6 gallons at 40 psi is required. The RP sprayer requires very little maintenance as judged by 1947 operations. RP sprayers were used for about three-fourths of the season during the whole of which 218,245 units were sprayed with a total of 568,971 gallons of emulsion.

Figure 1. The Regulated Pressure sprayer ready for use. The carrying position of the sprayer is well illustrated here.

No particular difficulty has been encountered in training unskilled men to operate the RP sprayer, and at least 90% of the crew members prefer it to other sprayers. Its greater weight (total — 19 lbs.) was considered objectionable originally, but few complaints on this score were received from field operators.

Operations data for 1947 indicate that the daily emulsion output per man using the RP sprayer is at least 80% greater than when using the commercial type sprayer with hand pumps. Counting spray time as the total time spent at individual spraying sites, which includes mixing, loading and

spraying operations, the RP sprayer emulsion output (using 8002 nozzle — 40 psi) will range from six to 8.4 gallons per man-hour, depending upon the ability and teamwork of the crew members. Under rural Georgia conditions, the spray time will account for approximately 70% of the gross crew-time, with the remaining 30% utilized in travel and warehouse operations.

SUMMARY

1. A Regulated Pressure Sprayer has been designed. Approximately 500 were constructed and utilized on 1947 DDT residual spraying operations on the Georgia Malaria Control program which included 218,245 unit sprayings.

2. In comparison with single compartment sprayers, the demonstrated advantages of the RP sprayer are:

a. It permits the discharge of spray solution or emulsion at a uniform pressure and discharge rate.
b. The uniform discharge rate expedites crew training and improves the uniformity and consistency of surface application rates.
c. It requires a lower volume of air per unit volume of emulsion or solution discharged.
d. It requires less judgment and manual labor to operate.
e. Maintenance requirements are less and it may be constructed by an individual agency.
f. It considerably improves the efficiency of manual spraying operations.

3. The RP sprayer has been used on only small-scale larviciding operations, but its advantages on such operations paralleled those noted on residual spraying operations.

4. The regulated air pressure — two compartment principle may be applied to the design and construction of sprayers utilizing different size air and liquid tanks, with higher or lower spray pressures.

Figure 2. Air and emulsion loading of the sprayer from a typical crew truck.

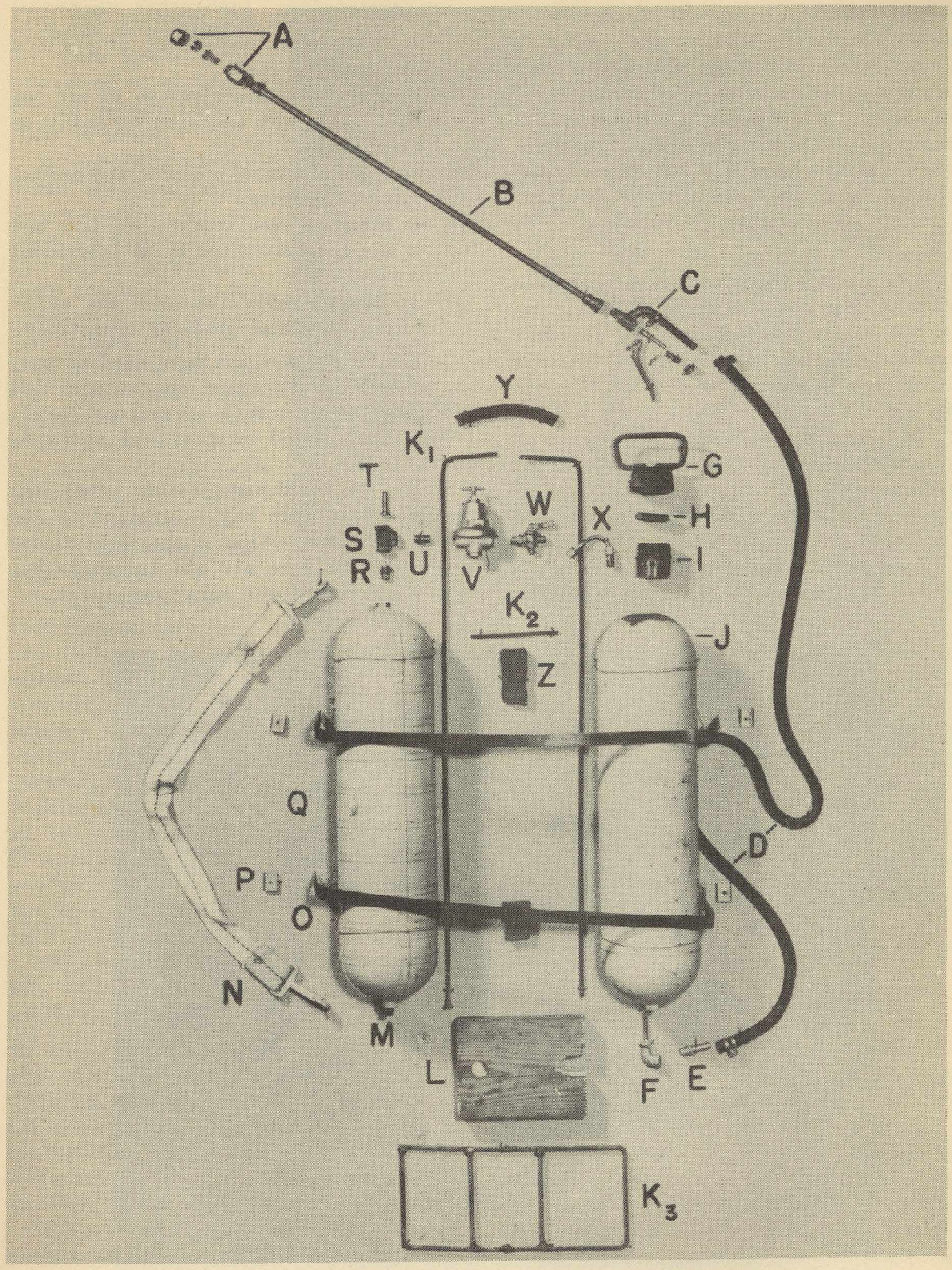


Figure 3. The Regulated Pressure Sprayer dismantled.
For key, see next page.

TABLE 1

FIGURE 3 KEY LETTER	NUMBER REQUIRED	DESCRIPTION
A	1	Nozzle (Spraying Systems 1/4T-8002).
B	1	Wand — 1/8" Pipe, 18-30" in length, fitted with 1/8" x 1/4" bushing and 1/8" x 1/4" reducer.
C	1	Shut off valve (Hudson).
D	1	Outlet hose — 1/4" ID, 5 1/2' long, Xylol resistant and equipped with hose clamp at both ends.
E	1	Hose bib, 1/4" male thread.
F	1	Street ell fitting, 1/4" with 2" length of 1/4" OD copper tube installed in male end.
G	1	Pipe cap, 1 1/2" equipped with handle made of 5/16" iron rod.
H	1	Gasket, 1/2" thickness, 1 1/2" diameter full circle, xylol resistant material.
I	1	Pipe nipple, 1 1/2" diameter, approximately 1 1/2" long, upper end threaded, side tapped and threaded for 1/4" SAE thread.
J	1	Emulsion Tank, 5" diam. by 23 1/4" length (U. S. Army Specifications No. 94-40355, Type D-2) with 1/4" female fitting at lower end and modified by cutting 1 1/2" diameter hole in center of upper end.
K	1	Carrying frame made of 5/16" iron rod and composed of 2 uprights (K_1), 5" cross brace (K_2) and base (K_3).
L	1	Base block, 2" x 6" x 8", with hole and notch to clear bottom fittings of air and emulsion tanks.
M	1	Pipe plug, 1/4".
N	1	Sling, 1 1/2" to 2" width, approximately 36" long and equipped with snaps or buckles at either end.
O	2	Banding straps, approximately 1/32" x 3/4" x 34" long.
P	4	Strap seals, 3/4" (Acme Steel Company No. 61 S).
Q	1	Air tank, same as J except that upper and lower end fittings consist of 1/4" female fittings.
R	1	Pipe nipple, 1/4" close.
S	1	Pipe tee, 1/4".
T	1	Air filling valve, (Schrader or equal).
U	1	Pipe nipple, 1/4" close.
V	1	Pressure regulator, 1/4" (Watts Regulator Company No. 26AC 1/4").
W	1	Stopcock, 1/4".
X	1	Flexible connection, composed of 4" length of 1/4" OD copper tubing; 2 — 1/4" female couplings; 1 — 1/4" SAE male connector.
Y	1	Carrying grip, 4" length of used hose either 1/4" or 3/8" ID.
Z	2	Separators, 1/2" x 1 1/2" x 2 1/2".

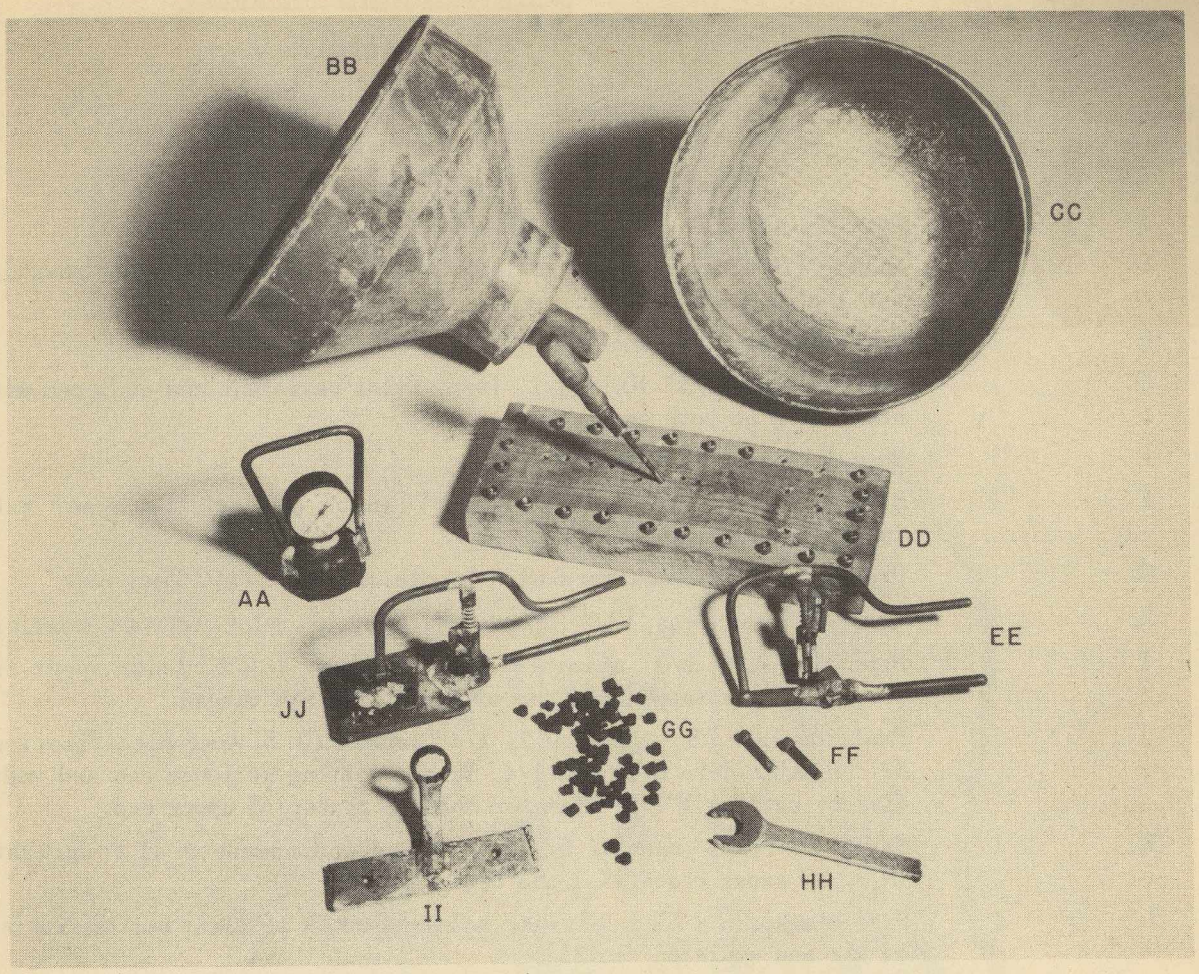
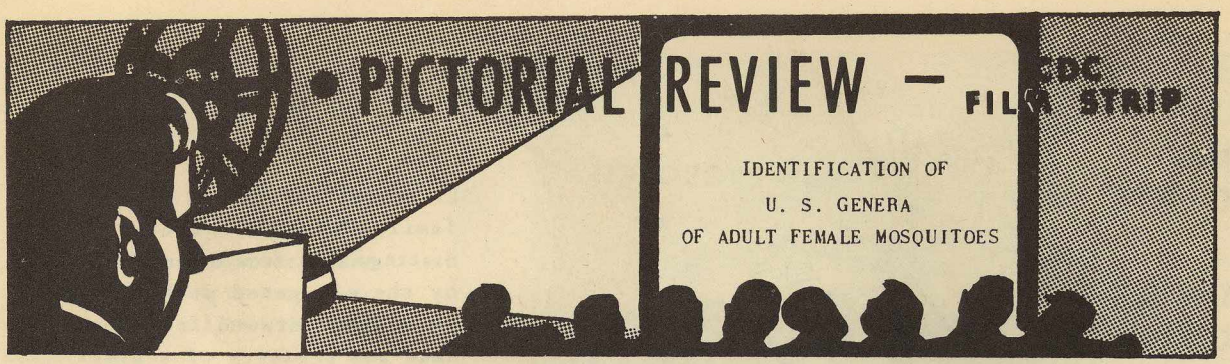


Figure 4. Accessory equipment described in Table 2.

TABLE 2

FIGURE 4 KEY LETTERS	ITEM DESCRIPTION
AA	Testing Cap — 1 1/2" pipe cap with dial gage (0-200 psi) connection to measure emulsion tank air pressure.
BB & CC	Side and top views of funnel used in straining emulsion as sprayer is filled.
DD	Block for holding shutoff valve plungers while removing defective tips.
EE	Tip inserter tool — portable type.
FF	Shutoff valve plungers without tips.
GG	Replacement tips for shutoff valve plungers.
HH & II	End and box wrenches (13/16") for separating nozzle.
JJ	Tip inserter tool — bench type.

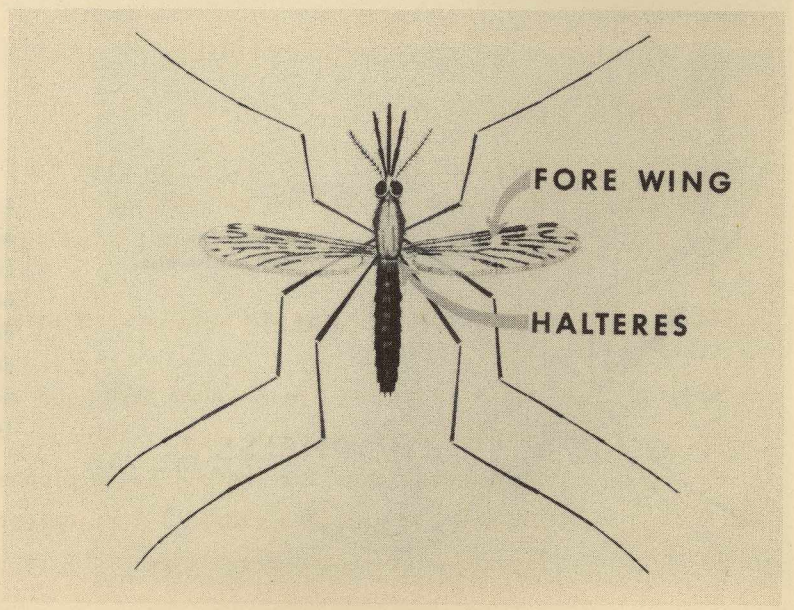


PRODUCTION NO. CDC 5-015 92 FRAMES

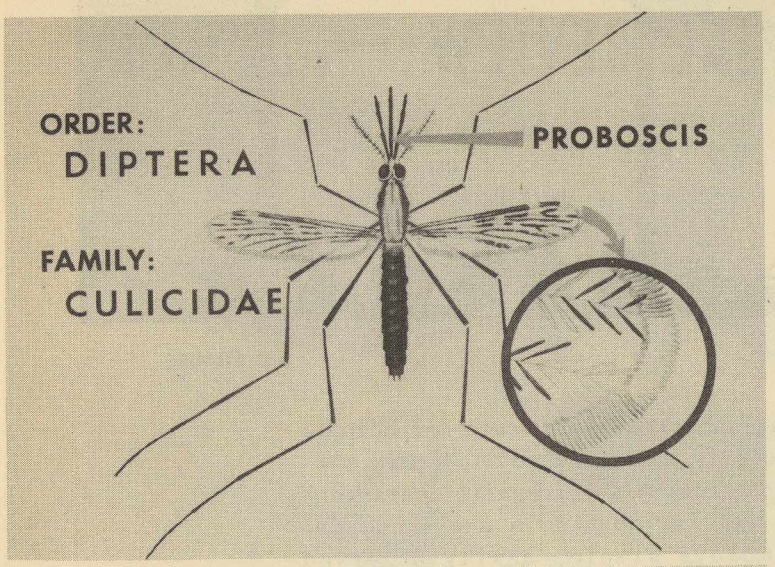
This color film strip is designed to teach morphologic characters used to identify genera of adult female mosquitoes of the United States. Also, specific characteristics of each genus are introduced. A new schematic key is used which employs simple, easily observed structures. Other characters in common use are indicated without elaboration. Introductory taxonomic information and methods of distinguishing mosquitoes from other insects are presented.

The unit is designed for use at the college level in instruction of entomology students, entomologic technicians, and advanced entomologic inspectors.

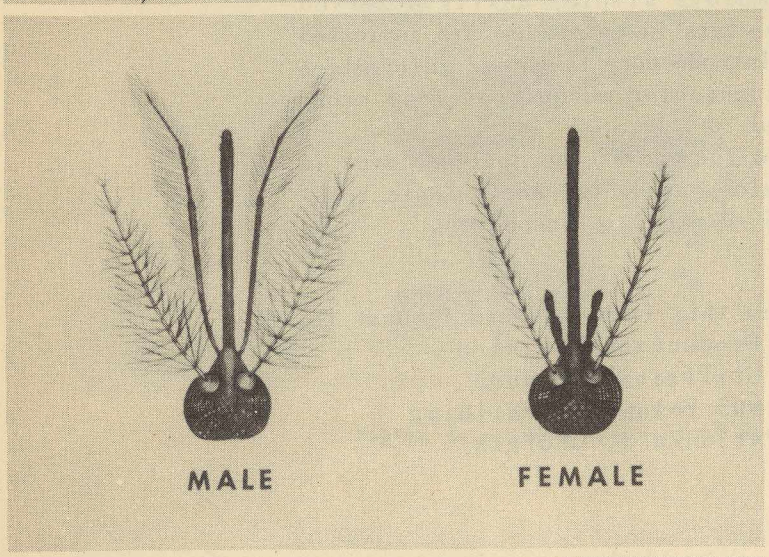
To obtain this film, address request to:
Production Division
Utilization Branch
605 Volunteer Building
Atlanta 3, Georgia



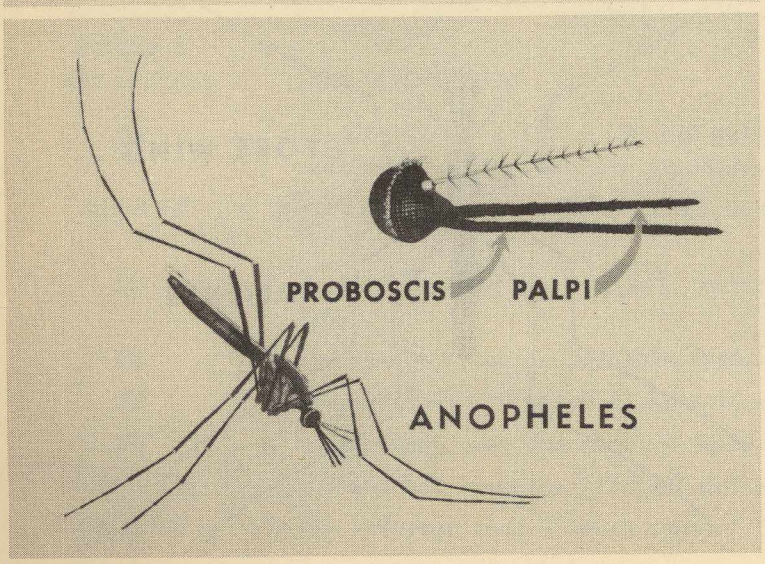
1. Mosquitoes are insects belonging to the order *Diptera* – the true flies. *Diptera* are characterized by the presence of well-developed fore wings. The vestigial hind wings are represented by short, knobbed halteres.



2. Mosquitoes belong to the family *Culicidae*. They are distinguished from other flies by the elongated proboscis extending forward from the head and presence of scales on the veins and border of the wings.

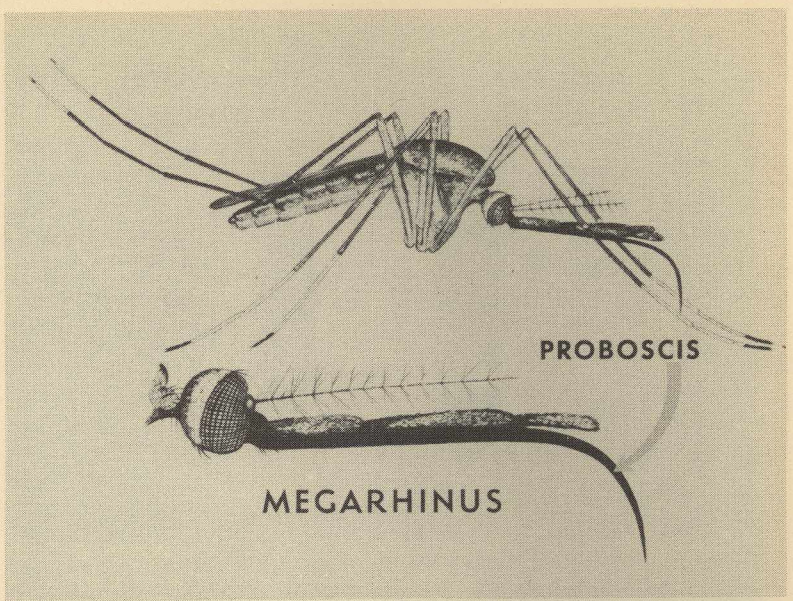


3. The sex of mosquitoes may be distinguished by the antennae. Those of the male are usually quite bushy. Female mosquitoes have slender, almost bare antennae. The identifying characters described hereafter apply to female mosquitoes only.

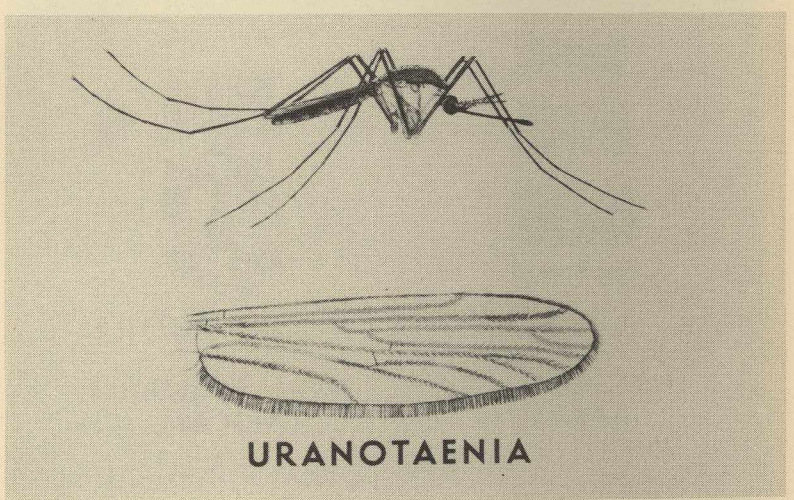


4. Correct identification of mosquito genera depends upon thorough familiarity with basic morphologic characters. Females of the genus *Anopheles*, unlike all other genera of mosquitoes, have palpi as long as the proboscis.

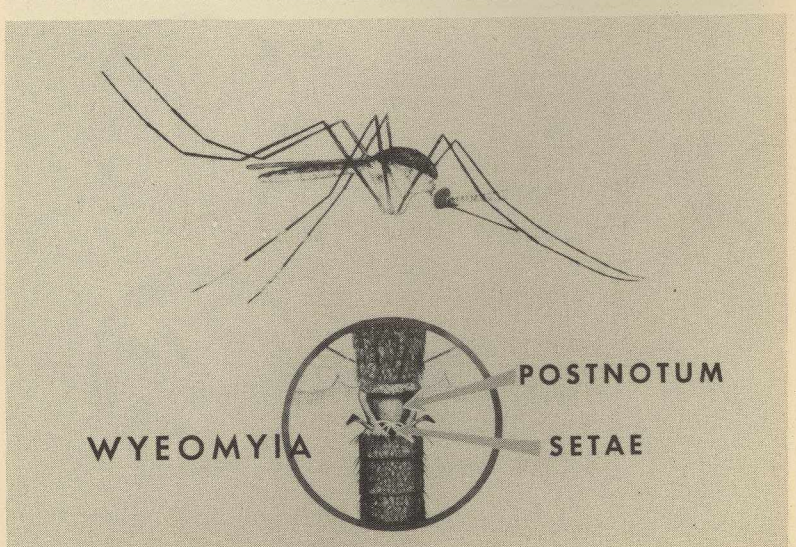
5. *Megarhinus* mosquitoes have a proboscis which curves downward sharply, unlike all other mosquitoes.

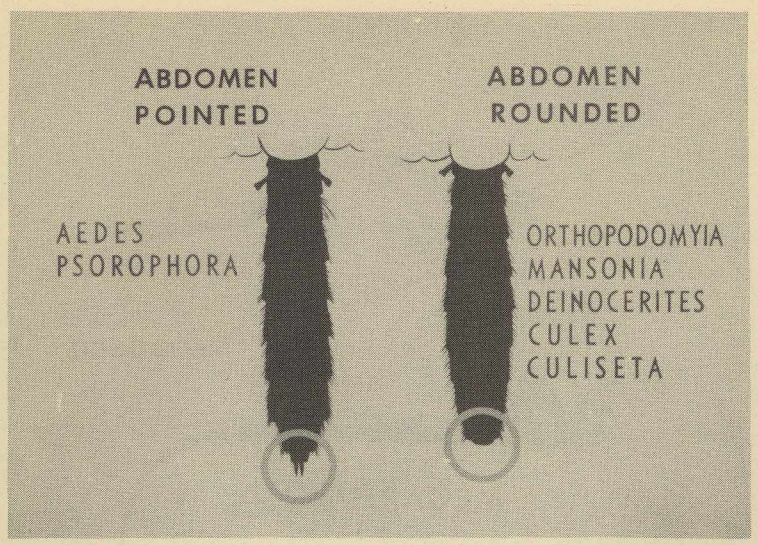


6. *Uranotaenia*, by contrast, are very small mosquitoes with bluish iridescent scales in rows or patches.

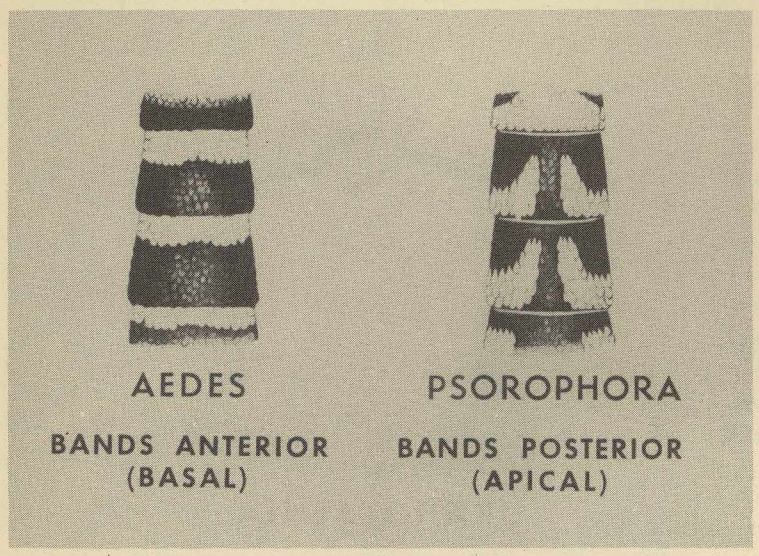


7. *Wyeomyia* may be recognized by the tuft of hairs or setae on the postnotum. Another characteristic of this genus is the longitudinal stripe on the sides of the abdomen.

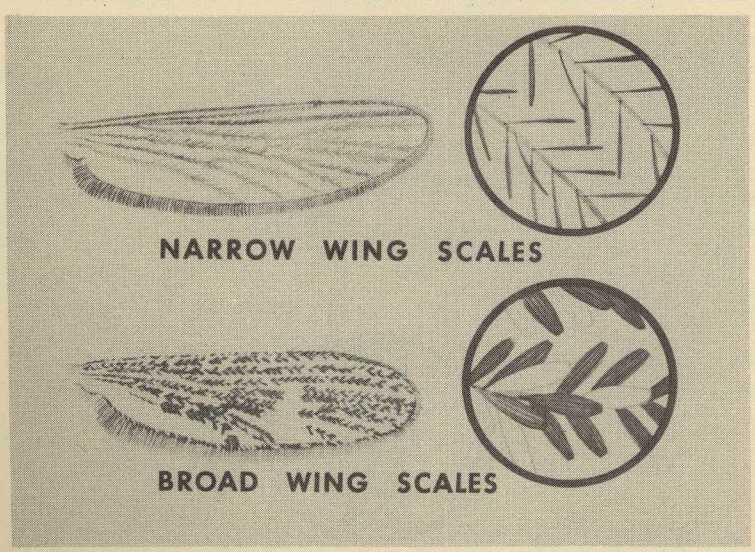




8. The remaining seven mosquito genera may be divided into two groups on the basis of the shape of the tip of the abdomen. The tip of the abdomen is pointed in two genera, *Aedes* and *Psorophora*. The remaining genera have blunt or rounded abdomens: *Orthopodomyia*, *Mansonia*, *Deinocerites*, *Culex* and *Culiseta*.

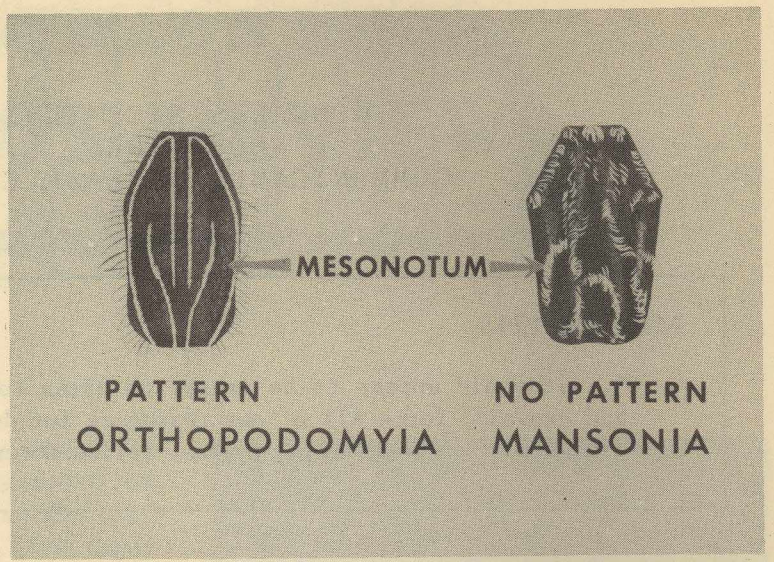


9. In the genus *Aedes*, a white band of scales occurs at the anterior or basal end of the abdominal segments. In contrast, *Psorophora* have the white band of scales located posteriorly or apically.

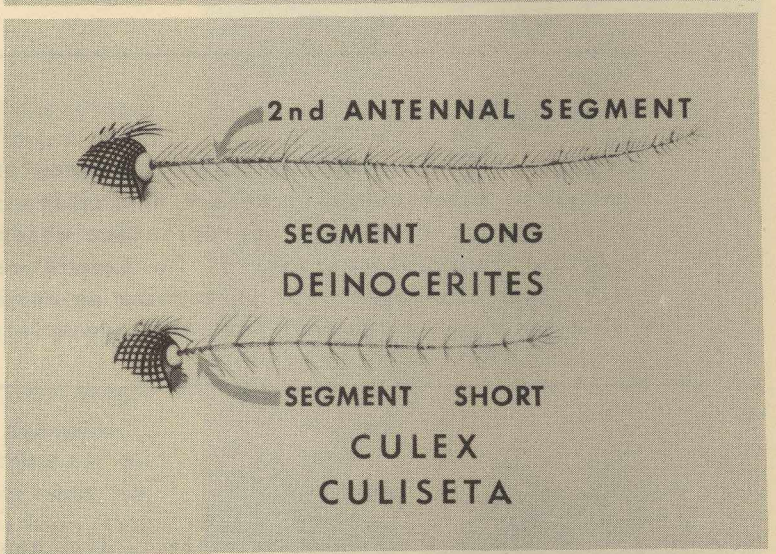


10. The genera with blunt abdomens may be further separated into two groups by using the size of wing scales. *Orthopodomyia* and *Mansonia* have broad, light and dark wing scales. *Deinocerites*, *Culex* and *Culiseta* usually have narrow wing scales.

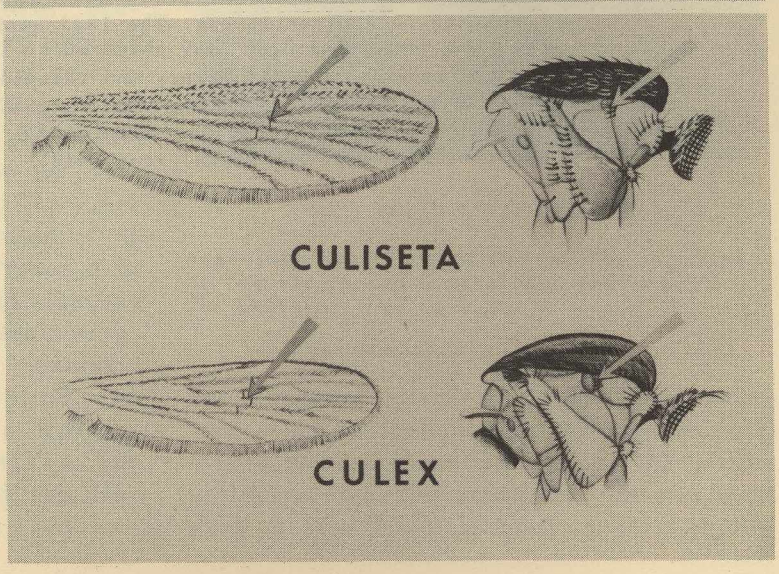
11. *Orthopodomyia* and *Mansonia* may be distinguished from each other by the pattern on the mesonotum. Scales on the mesonotum of *Orthopodomyia* form a definite pattern of delicate white lines. The dark and light scales on the mesonotum of *Mansonia* do not form a definite pattern.



12. *Deinocerites* is distinguished from *Culex* and *Culiseta* by the long second antennal segment. It is longer than the next two segments combined. In other genera it is short. The antennae of *Deinocerites* are much longer than those of other genera.



13, The last two genera, *Culiseta* and *Culex* may be differentiated by the presence or absence of spiracular bristles. *Culiseta* has spiracular bristles. *Culex* does not. In most species of *Culiseta* the cross veins arising from wing vein four are close together. In *Culex* they are widely separated.



CONGRESS SAYS THIS ABOUT THE COMMUNICABLE DISEASE CENTER

May 14, 1945

"...it would appear to be proper to bring together in a coordinated and expanded force all of our resources for dealing with insect-borne diseases, such as malaria, typhus, yellow fever and dengue."

March 5, 1948

"The over-all amount allowed provides for some relatively small increase in essential research activities in the several specific fields embraced by this appropriation which covers a wide and important range of activities. The Committee is impressed with the fact that this agency is performing an essential job in a commendable fashion — a job that must have adequate and continuous support."

(These statements are extracts from reports of the House Committee on Appropriations. The 1945 quotation is from the report accompanying H. R. 3199 which authorized appropriations for the Federal Security Agency and related independent agencies for the fiscal year ending June 30, 1946. The March 5, 1948 quotation is from a report accompanying H. R. 5728, a similar appropriation bill for fiscal year 1948.)

BOOK REVIEW

RH...ITS RELATION TO CONGENITAL HEMOLYTIC DISEASE AND TO INTRAGROUP TRANSFUSION REACTIONS by Dr. Edith Louise Potter; The Year Book Publishers, Inc., Chicago; 1947; 344 pages; $7.50.

This monograph presents an interesting review of material on the Rh factor that has accumulated to date. The Rh factor is considered in relation to genetics, pathology, obstetrics, pediatrics, serology, hematology, and other special fields. Information in the book is based on the work of many investigators. The bibliography contains 794 titles.

Discovery of the Rh factor, its properties, and its antibodies are discussed. The role of the Rh factor in production of pathologic changes and its importance in intragroup transfusion reactions are described. The diagnosis, prognosis, history, and prevention of hemolytic disease is considered. Sections are included on complications and sequelae of the disease and a general classification of diseased fetuses and infants. The section on postmortem examinations is excellent. The chapter on "Technics for Determination of Rh Status of Red Blood Cells and Presence of Rh Antibodies" gives general laboratory technics of Rh and antibody determinations.

Dr. Potter substitutes the term "hemolytic disease" for "erythroblastosis fetalis" in the hope that it will serve as a designation for a specific disease entity. She states that before the Rh factor was discovered (1941) "erythroblastosis" had lost its original meaning. It had been used frequently to include many other pathologic states besides those included in the original definition. She hopes that the new term will be used "in a limited sense" and not

DR. EDITH LOUISE POTTER

Associate Professor of Pathology, Department of Obstetrics and Gynecology, Medical School, The University of Chicago.

taken as "a synonym for the hodgepodge of conditions often associated with the older name."

Dr. Potter refutes the idea that the Rh factor is related to abnormalities of pregnancy. It is recommended that circulation through the cord of the affected fetus be interrupted immediately after delivery. The author decries the belief that the Rh-negative status of a woman is necessarily responsible for the death of a fetus. In her 157-page chapter on "Hemolytic Disease" the following statement is made:

> "Twenty to 25 percent of all fetuses who are not born alive die before the onset of labor as a result of unknown causes operating during the last few weeks of pregnancy. Such deaths occur in the offspring of both Rh-negative and Rh-positive women, and there is no reason to believe that the Rh-negative status of the mother is responsible for the death unless there is some evidence of hemolytic disease in the fetus or proof of immunization in the mother. Hemolytic disease rarely causes death during the last trimester of pregnancy without producing some visible abnormality, and the great majority of fetuses with no pathologic changes demonstrable on post-mortem examination must be considered free from the disease."

Although the reason for the rarity of the disease in the first pregnancy is not definitely known, Dr. Potter lists the following possible causes:

> 1. Antibodies are not produced in a first pregnancy.
> 2. Antibodies are formed but are prevented from reaching the fetus.
> 3. Antibodies are produced but not in sufficiently high concentration to injure the fetus.
> 4. Some condition associated with delivery is responsible for the entrance of fetal cells into the maternal circulation, and immunization is not accomplished until after the birth of the baby.

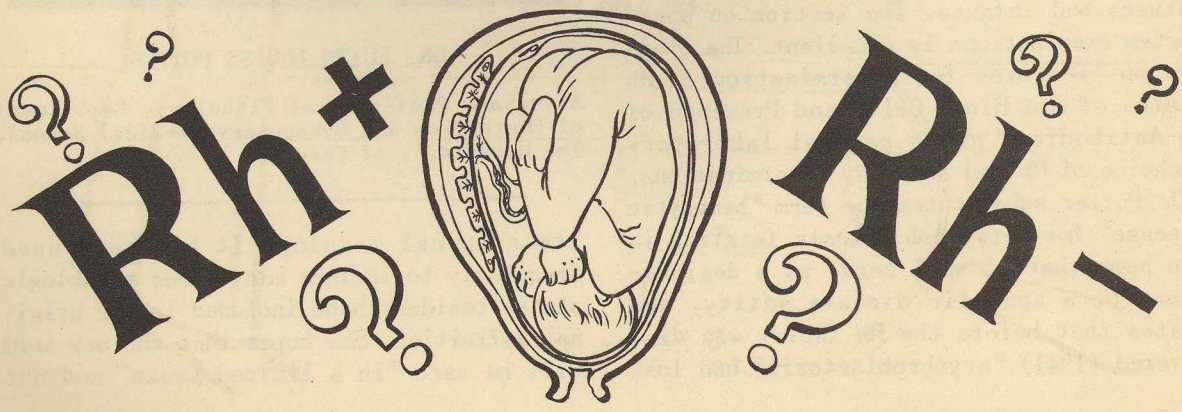
The author states that the third and fourth possibilities seem the most reasonable but discusses each cause at length.

In a discussion on treatment of hemolytic disease, Dr. Potter relates that some investigators recommend wide application of exsanguination transfusions. Her answer to this is as follows:

> "From the excellent results obtained by the clinics where infants with hemolytic disease are being carefully watched and properly treated by ordinary transfusion of Rh-negative blood, it seems probable that exsanguination transfusions do not provide a sufficiently improved outlook for the life of the child to warrant encouraging their use."

The illustrations in the book are excellent. There are 17 tables and 65 figures (including 58 remarkable photographs of gross and microscopic specimens). Dr. Potter has assembled a vast amount of information. Many controversial views are presented but this is to be expected in such a comprehensive treatise.

Readers who disagree with statements made should remember Dr. Potter's plea to "accept this material as a discussion of material in flux and subject to change at any moment." This stimulating volume will be valuable to those persons who want only a general knowledge of the subject as well as to specialists.



SPECIAL PROJECTS

• SINGLE RESIDUAL DDT SPRAY RECOMMENDED

During 1947 trial projects were conducted in two states to determine the effectiveness of a single residual DDT spray for an entire season. Results indicated that the effectiveness of the single spray is comparable to that of two sprayings. Studies made at Savannah, Georgia showed that a single spray application of 200 mg. per square foot gave satisfactory results on the interior of houses if *all* surfaces in the rooms were completely covered.

Effectiveness both in terms of percentage of kill and duration was in direct proportion to the thoroughness of treatment. The effectiveness of the spray at the end of six months in rooms containing treated furniture was approximately equal to that at the end of only three months in rooms where furniture was untreated. Single applications made as early as April gave satisfactory results over the entire mosquito breeding season. No distinct advantage was found for application rates higher than 200 mg. per sq. ft.

A single, complete interior spray application of 200 mg. per square foot is recommended for the 1948 season (Extended Program Memorandum No. 16-1947). Premises where malaria is known to exist should be sprayed completely. Otherwise, routine spraying of entire premises (homes, privies, barns, stables, etc.) is permissible only when local funds are available. A high degree of protection from malaria appears to have resulted during the past three years with spraying limited to houses and privies.